FOREWORD

Volume I of the Index to Users Projects has been published to provide a source for immediate reference to all Users Projects from Number 1 to Number 399.

Volume II of the Index to Users Projects is a continuation of Volume I and contains those projects produced from Number 400 to date and is available upon request.

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339	1	Lerbs' Propeller Pitch Correction	Intercom 1000 S.P.	340
340	1	Solution of n Simultaneous Al- gebraic Equations with Symmetric Coefficients	Intercom 1000 D.P.	341
341	1	Inverse by Vector Matrix Multi- plication	G-15D	342
342	1	Geographic Positions to Plane Coordinates, Plane Coordinates to Geographic Positions	Int. 1000 D.P.	343

U.P. NO.	CLASS	TITLE	MODE/EQUIP.	PAGE
343	2	Parcel Description from Station and Offset Data	Intercom 1000 D.P.	344
344	2	Ramp Terminals	Intercom 1000 D.P.	345
345	2	Earthwork Volumes and Mass Diagram	Intercom 1000 24A	346
346	1	Degrees, Minutes, and Seconds to Decimal Degrees and Vice Versa	Intercom 1000 D.P.	347
347	2	Eigen Values and Eigenvectors	Intercom 103	348
348	1	Bridge Pier Analysis	Intercom 1000 S.P.	349
349	1	Modified Bessel Functions of the Second Kind	Intercom 1000 D.P.	350
350	2	DAISY 201 Appendix #053 - Read MAP-29 Tape	G-15D	351
351	2	$J_0(x)$, $J_1(x)$, $Y_0(x)$ and $Y_1(x)$	G-15D, (Int. 302- SADIE)	352
352	2	$J_0(x)$ and $J_1(x)$	G-15D (Int. 302- SADIE)	353
353	2	Stringer Layout for Bridge on Spiral	Intercom 1000 D.P.	354
354	2	Beams on Elastic Foundations	Intercom 1000 and 101	355
355	2	Storm Drainage System Design	Intercom 1000 S.P.	356
356	1	Reverse Punched Paper Tape	Intercom 1000 D.P.	357
357	2	Lagrange Interpolation	DAISY (Int. 201)	358
358	2	Traverse Computations	Intercom 1000 D.P.	359
359	1	Index Register Subroutine	Intercom 1000 S.P.	360
360	2	Partial Fraction Expansion Program	Intercom S.P. and Machine Language	361
361	2	Plate Girder Flange Properties Table Generation	Intercom 1000 S.P.	362
362	2	Fourier Synthesis	Machine Language (S.P.)	363

Į	J.P. NO.	CLASS	TITLE	MODE/EQUIP.	PAGE
	363	2	Stringer Geometrics and Eleva- tions for Bridge on Circular Curve	Intercom 1000 D.P.	364
	364	1	PEEK (Program Explorer Editor Keeper)	Machine Language (S.P.)	365
	365	2	Swedish Slip Circle Analysis	Machine Language (S.P.	366
	366	1	Arithmetic Integration of Simple Surge Tank	Machine Language	367
	367	2	Report Index Search - Tape Justification	Machine Language	368
	368	2	Report Index Search - File Preparation	Machine Language	369
	369	2	Report Index Search - Question Analyser	Machine Language	370
	370	2	Report Index Search - File Searching Routine	Machine Language	371
	371	2	Report Index Search - File Correction and Up-Dating Routine	Machine Language	372
	372	2	Report Index Search - Service Routines	Machine Language	373
	373	1	Complex Error Function and Complex Error Integral	Intercom 1000 D.P.	374
	374	2	Gamma Function Subroutine	Intercom 1000 D.P.	375
	375	2	Intercom 1000 D Fixed-Point Output Subroutine	<pre>Intercom 1000 D (Appendix Subroutine)</pre>	376
	376	1	Fit Analysis by Least Squares (FABLES) (Rev. of UP #138)	Int. 1000 S.P. or Intercom 500	377
	376A	1	Fit Analysis by Least Squares (501 FABLES) Modification of Users Project No. 376	Int. 500 or 501	378
	377	1	Decimal to Binary Conversion and Sum of Entire Line	G-15D (Machine Lang.)	379
	378	1	AROWA FLIT - 3 (FLIT)	Machine Language	380
	379	2	Three Column Pier Analysis	Int. 1000 S.P.	382

<u>U.P. NO.</u>	CLASS	TITLE	MODE/EQUIP.	PAGE
380	2	Spiraled Bridge Detail Geometry	Intercom 1000 D.P.	383
381	2	Determination of Transfer Function Time Response	G-15D	384
382	2	Calculation of a Correlation Matrix (two to fourteen variables)	Intercom 1000, G-15D CA-1	385
383	2	Stadia Note Reduction	Int. 1000 D.P.	386
384	1	Quadrilateral Adjustment (Logarithmic)	Intercom 1000 D.P.	387
385	2	Payroll Job Costs	Machine Language (S.P.)	388
386	2	Continuous Highway Bridge Girder Maximum- Minimum Moments	Intercom 1000 S	389
387	2	Rigid-Frame Bridge Influence Lines	Intercom 1000 S	390
388	2	2 Column 2 Story Rigid Frame	Intercom 1000 S	391
389	1	General Purpose Geometry - (Suppl. to U. P. #203)	DAISY 201	392
390	2	Intercom 610	Machine Language (Autopoint 24 Subroutines	393 s)
391	2	Intercom 107	G-15D	394
391 - A	2	Intercom 107 (Rev. 7/22/60)	G-15D	395
392	2	Bridge End Span Geometry	Intercom 1000 D.P.	396
393	1	Forecasting Ship Arrivals	Intercom 1000 S.P.	397
394	2	Tangent, Circular Curve and Transition Spiral Intersection, Offsets, Coordinates, Eleva- tions, Stationing and Concen- tric Arc Lengths	Intercom 1000 D.P.	398
395	2	Design of Reinforced Rectan- gular Concrete Tank	Intercom 1000 S.P.	400
396	2	Roadway Elevations	Machine Language	401

U.P. NO	CLASS	TITLE	MODE/EQUIP.	PAGE
39 7	2	Pier Location	Intercom 1000 D.P.	402
398	2	Machine Language Vertical Alignment Program	G-15D	403
399	1	Bowling Scores	G-15D	404

USERS' PROJECT NO. 1

Abstract

PROGRAM DOCUMENTATION ROUTINE

This is a service routine designed to document programs from tape in G-15 language.

USERS PROJECT NO. 2

Abstract

INTERCOM 101

The program was documented by Bendix Radio Division and contains a complete set of flow charts and coding sheets for INTERCOM 101 interpretive routine.

USERS PROJECT NO. 3

Abstract

FLOATING POINT DOUBLE PRECISION SUBROUTINES

The project is a set of subroutines including square root, trigonometric exponential routines as well as erf(x) and Table Generator.

USERS' PROJECT NO. 4

MATRIX INVERSION AND SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS

PROBLEM DESCRIPTION

This program is designed to invert matrices or solve a set of simultaneous linear equations of order up to and including 15, by using Gaussian elimination. Floating Point Double Precision arithmetic is used throughout all computations.

Each row of the matrix is assigned a line beginning with line Oh and continuing up to line 18 if necessary. Lines to be used should be cleared before entering numbers. The first column of numbers are stored in two word positions starting at the even number location 076; the second column in location 074, etc.

If simultaneous equations are to be solved, the constant term is entered starting in location 078.

USERS PROJECT NO. 5

Abstract

REAL AND COMPLEX ROOTS OF A POLYNOMIAL

The routine will find the roots of a polynomial of the degree n where $3 \le n \le 17$, by Milne's quatratic factoring method.

USERS PROJECT NO. 6

Abstract

FLEXOWRITER TO INTERCOM NUMBER CONVERSION

The program is a service routine for off-line data preparation when using INTERCOM 101.

USERS PROJECT NO. 7

Abstract

MICHIGAN STATE HIGHWAY DEPARTMENT EARTHWORK PROGRAM

The volume of earth, i.e., cut and fill, is computed with other items such as station, plan grade, areas, etc.

SOLUTION OF SIMULTANEOUS LINEAR EQUATIONS

The method used in this program is the method of elimination. The equations are multiplied by certain factors and then subtracted one from another until all unknowns but one are eliminated from the last equation. The value of the other unknowns can then be found by either back substitution or by a method which will be explained later. Consider the set of equations:

Dividing equation 1 by all one obtains

$$x_1 + c_{12}x_2 + \cdots + c_{1n} = b_1'$$
 where $c_{i,j} = a_{i,j/a_{11}}$

Then, multiplying equation 1 by a_{21} and subtracting equation 1 from equation 2 eliminates x_1 from equation 2. Equation 2 becomes

$$d_{22}x_2+d_{23}x_3+ \dots d_{2n}x_n = b_2^n$$

where $d_{2j} = a_{2j} - a_{2l}c_{ij}$, dividing equation 2 by d_{22} gives

$$x_2 + e_{23}x_3 + \dots + e_{2n}x_n = b_2$$
 where $e_{ij} = \frac{d_{ij}}{d_{22}}$

Using equation 1 eliminates x₁ from equation 3, and using equation 2 eliminates x₂ from equation 3. Proceed in this manner until equation n is obtained:

$$S_{nn}x_n = b_n^{(1)}$$

of
$$x_n = b^{(1)}$$
 S_{nn}

It is now possible to use back substitution to obtain the other unknowns.

Substituting $x_n = b^{""}/S_{nn}$ in the derived equation n-1:

$$T_{n-1,n-1}x_{n-1} + T_{n-1,n}x_n = b_{n-1}$$

xn-l is obtained. By repeating the process all x1 are obtained.

Users' Project No. 8

SCLUTION OF SIMULTANEOUS LINEAR EQUATIONS (Continued)

A simpler method to find all x_i after x_n has been found is used in this program. Consider the derived equations

$$x_1 + k_{12}x_2 + \cdots + k_{1n}x_n = L_1$$
 $x_2 + k_{23}x_3 + \cdots + k_{2n}x_n = L_2$
 $k_{nn}x_n = L_n$

Multiplying equation 2 by k_{12} and subtracting it from equation 1, eliminates x_2 from equation 1. Proceeding in this manner, all unknowns, except x_1 , are climinated and the solution for x_1 follows immediately. Then, ignoring equation 1, eliminate all except x_2 from equation 2, etc.

DIMPLES USERS' PROJECT NO. 9

Preface

The purpose of this work was to assemble in one package the basic useful features of floating point double precision notation. The unique feature is a "table generator", which is used to provide tables of functions to a high degree of precision. Its usefulness lies chiefly in two areas: (1) Standard functions for which a table may not be conveniently at hand, or which may not give the desired precision. (2) Special functions which may be designed to provide the answer to a specific problem. Also included is a program preparation routine, and an "open-end" feature which makes it possible to add on sub-routines of varying complexity.

Users' Project No. 10

MATRIX INVERSION

The method used in this program is the method of direct elimination. Consider the n x n matrix $a_{ij} = A$. If A^{-1} exists, $AA^{-1} = I$. By introducing the composite matrix $\begin{bmatrix} A & I \\ I & O \end{bmatrix}$ and using direct elimination on it, the composite matrix $\begin{bmatrix} A & O \\ I & O \end{bmatrix}$ is generated where C is the inverse of A.

Step 1: Start with the composite matrix [A | I]. Divide row 1 by a_{1,1}. Then multiply row 1 by a_{2,1} and subtract row 1 from row 2. This gives zero in the a_{2,1} position. Then divide row 2 by a¹_{2,2}. Next, multiply row 1 by a¹_{3,1} and subtract it from row 3. Now multiply row 2 by a¹¹_{3,2} and subtract it from row 3. This eliminates a_{3,1} and a_{3,2}. Then row 3 is divided by a¹¹¹_{3,3} and the process is continued until the following matrix is formed:

MAISIE

USERS' PROJECT NO. 11

Preface

The purpose of this work was to provide a quick and easy method of inverting matrices and of solving simultaneous equations. It was desired to make the program as automatic as possible, in order that it might be run by an inexperienced operator. For convenience and accuracy, double precision floating point notation was chosen. The limit of 15 equations, or of a 15 x 15 matrix, was designated because not only was this a natural limit for the sexadecimal system, but it also coincided with the number of lines available in the machine.

USERS' PROJECT NO. 12

INTERCOM 103 D

I. General

INTERCOM 103D is an expanded version of INTERCOM 101D designed to increase the number of operations available to the programmer through the use of operation codes, to increase the speed and reliability of input/output operations, to reduce execution time, and to simplify the entry of information.

All Operation Codes available with INTERCOM 101 are present here. Similarly, all Instruction Codes have been retained.

Unless otherwise specified, the description and instructions given in the INTERCOM 101 Manual may be considered valid here.

II. Loading

The tape does not contain a number track. Loading may be accomplished by typing p and turning the Compute Switch to GO.

The loading routines check reading accuracy and reread if necessary.

Only three blocks are changed when going from Compiler to Interpreter and back. Index Registers are not disturbed. The loaders for entry of the Interpreter and return to the Compiler may be called in with a p instead of the x instruction if desired.

III. Input to Compiler

All instructions, orders, and numbers are entered with the Compute Switch on GO. Entry of an instruction is signalled by a preceding /.

Orders and numbers may be entered in the normal fashion; however, it is not necessary to enter trailing (insignificant) zeroes. Leading zeroes and zeroes that are part of an instruction must, however, be entered. Also, in the event that a typing error is made and discovered before the s is typed when entering orders and numbers, the error may be corrected by typing in the full 6-digit order or 7-digit number.

The number zero (12,00000) may be entered by typing only s.

NOTE: of operation will not work in the compiler, but will act as if an 0000 instruction had been given.

USERS PROJECT NO. 13

MAGNETIC TAPE PREPARATION ROUTINE (MTPR)

Functions:

The functions of the MTPR routine are: to transfer program blocks to Magnetic Tape from either Punched Tape or from the computer itself and to locate and "read in" blocks of information stored on Magnetic Tape.

The basic package is stored and operated from line O4. Line 18 is used for working storage (the same as in the PPA-D1 routine). The arithmetic registers and all four word lines are used by the routine. The routine is written so that it can be used together with PPA-D1, if so desired. It can also be used separately.

Loading:

The routine is self-contained and self-loading. To load the routine into the computer, hit the "p" key once with the Enable Switch on. After the photo tape reader has stopped, place the compute switch to either BP or CO. The loading procedure terminates with the computer prepared to accept input from the typewriter. The standard formats for AR and line 19 outputs are stored by the routine.

Users' Project No. 14

TRAVERSE CLOSURE AND DMD CALCULATIONS

The Traverse Glosure Program was designed to be a rapid means of checking office calculations in terms of bearings and distances and also to be used to calculate missing bearings and distances.

The program, at the option of the operator, will also compute the area of a closed l'igure in square feet and in acres.

The output formats of the program were designed for use with card input equipment, however, only one command change is necessary to allow the data to be typed in. Also, the output is on punched paper tape to be transcribed by off-line flexowriters but can be easily revised to type-out.

A special feature of the program is the continuing traverse routine which will allow any number of unknown courses to be computed in a single traverse.

In the near future a routine will be added to the program which will compute any two unknowns in a traverse.

Users' Project No. 15

NUMERICAL SOLUTION OF SIMULTANEOUS ORDINARY DIFFERENTIAL EQUATIONS

Problem: This program was prepared to compute the numerical solution of a system of first order simultaneous ordinary differential equations. As written it will handle twenty such equations, but can be easily modified to handle a larger system of equations. The Runge Kutta-Gill method is the numerical method used in this program.

Equations: Given N simultaneous equations

$$\frac{dy_1}{dx} = f_1(y_0, y_1, \dots, y_1, \dots, y_{n-1}) = f_1$$

$$(0 \le i \le N-1)$$

it is necessary for one to prepare a program to compute and store hfi in storage locations 470 + 1. This program is to start in location 100 and is entered by "MARK PLACE AND TRANSFER". It should end with a "RETURN TO MARKED PLACE" command.

USERS PROJECT NO. 16

INTERCOM Documenter No. 1

OPERATING INSTRUCTIONS

This routine may be used with the following interpretive systems: FLIP A, FLIP B, INTERCOM 101. INTERCOM 103.

- 1. Load the compiler in the normal fashion, and read the tape to be documented into the interpretive memory.
- 2. Place the INTERCOM Documenter No. 1 tape on the photo reader, ready to be read in. Turn the "Compute" Switch OFF.
- 3. Type p (*) and wait for the photo reader to stop.
- 4. Type of 0180261 Tab sicl. Place the "Compute" Switch to GO. The computer will read in the second block of the documenter tape, and it will stop with both "Source" and "Destination" lights showing 14. Turn the "Compute" Switch to OFF.
- 5. Type of abc 0 Tab s, where abc = the location at which documentation is to start. Insert sheet on which documented output is to appear.
- 6. Place the "Compute" Switch to GO. The computer will document successive interpretive memory locations, typing the location number followed by an order, a number, or a blank (if that location was unused). ***
- 7. To interrupt documentation, place the "Compute" switch in BP. The computer will stop at the end of the current line of output. To continue with the next location, place the "Compute" switch to GO.
- 8. To start documentation at a new location, start with step 5.
- 9. To load a new tape for documentation, start with step 1.
- * Underlined type-ins are made with the "Enable" Switch ON.
- ** There is one chance in about 4,000 that a number will be interpreted as a store order. Also, the first number documented following a sequence of orders may be converted incorrectly if this routine is used with certain versions of INTERCOM.

Check sums: .0000000 -.756yll6

FIXED ARCH AMALYSIS

GIVEN: A General Structure which follows any single path from 0 to R (0 and R may be at the same elevation; a ring-type structure)

The program computes influence values for Horizontal Reaction, Vertical Reaction, and Moment at the left support due to unit vertical loads.

The input data required is as follows:

ds = length of each segment

t = thickness at the face of each segment

x =) co-ordinates of the centroid of

y =) each segment

The program solves the following simultaneous equations:

$$-(\Sigma \mathbb{N}_{s} \mathbb{Y} \frac{ds}{EI}) = \mathbb{H}_{L} (\Sigma \mathbb{Y}^{2} \frac{ds}{EI}) + \mathbb{V}_{L} (-\Sigma \mathbb{X} \mathbb{Y} \frac{ds}{EI}) + \mathbb{N}_{L} (\Sigma \mathbb{Y} \frac{ds}{EI})$$

$$+(\sum \mathbb{M}_{s} \times \frac{ds}{EI}) = \mathbb{H}_{L} \left(-\sum XY \frac{ds}{EI}\right) + \mathbb{V}_{L} \left(\sum X^{2} \frac{ds}{EI}\right) + \mathbb{M}_{L} \left(\sum X \frac{ds}{EI}\right)$$

$$+(\Sigma \mathbb{M}_{s} \ \frac{\mathrm{d}s}{\mathrm{EI}}) = \mathbb{H}_{L} \ (-\Sigma \mathbb{Y} \ \frac{\mathrm{d}s}{\mathrm{EI}}) + \mathbb{V}_{L} \ (\Sigma \mathbb{X} \ \frac{\mathrm{d}s}{\mathrm{EI}}) + \mathbb{M}_{L} \ (\Sigma \frac{\mathrm{d}s}{\mathrm{EI}})$$

The six different coefficients on the right side of the equations are "Structural Constants" and, once determined, remain fixed for any given structure. The three values on the left side of the equations must be determined anew for a load positioned at each segment of the structure.

USERS! PROJECT NO. 19

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK
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Bridge Bearing Elevations

Abstract

Given the final horizontal and vertical alignments and the complete design of the slab, beams, and bearings, it is required to determine the bridge seat or bridge bearing elevations for highway bridges on horizontal tangents with or without vertical curves. The bearing line number, the beam numbers, and the required bearing elevations are typed out as a group for every bearing line.

The capacity of the program is 10 single spans with no restrictions on the number of beams in a span, the skew angle or the arrangement of the fixed and expansion bearings.

This program is revision one.

Supplement No. 1 to Users' Project No. 20 ILLINOIS DIVISION OF HIGHWAYS

First Modification of Earthwork Program adapting it to the Design of Dual High-ways which are Symmetrical about the Centerline of Median.

(For G-15A)

The Earthwork Program as originally developed was limited in its use to the design of a single pavement roadway (with any number of lanes). A modification of the original program has been completed which permits its use in the earthwork design for dual highways with any number of lanes, but which have a uniform median width and grades that are parallel (although not necessarily at the same elevation) and for which superelevation is obtained by rotating the pavements about their median edges.

This program for dual highways is the same as the original program, except that a new Template Simulation Subroutine has been substituted for the original Template Simulation Subroutine. In order to obtain the desired location in memory storage for the new subroutine, some of the orders in a few of the other subroutines have been relocated into other memory lines.

The only difference in operational procedures from those given in the original manual is in the preparation of the Template Data tape. Instructions for this procedure are included in the following pages.

Supplement No. 2

SECOND MODIFICATION OF EARTHWORK PROGRAM ADAPTING IT TO EARTHWORK DESIGN FOR WIDENING EXISTING PAVEMENTS

Changes in Original Program:

- 1. The Crown Elevation Subroutine has been omitted.
- 2. A new Template Simulation Subroutine has been substituted.
- 3. Grade Line Data Tape is not required.
- 4. There is a new procedure for the preparation of Template Data

 Tape and Ground Cross Section Tape.

Crown Elevation:

The Crown Elevation is taken from the Ground Cross Sections, and is the rod elevation at the centerline of survey which is usually the centerline of the existing pavement or a line which is parallel to, but offset from the existing pavement centerline. The program, as a part of the conversion of cross section rod readings to actual elevations, sets the centerline elevation in position for output as Crown Elevation. The output format contains the Crown Elevation (and all other output data) in the same position as in the output format for the original Earthwork Problem.

Users' Project No. 21 Supplement No. 4

EARTHWORK PROGRAM -- USING CROSS SECTIONS COMPRISED OF ELEVATIONS AND OFFSETS

General Statement:

This program is the same as the original Illinois Earthwork program, except that Section "B" (Cross Section Data Entry and Conversion) has been rewritten so that the computer will accept cross sections expressed in x, y and z coordinates; that is, stations, offsets and ground elevations.

For this program the accompanying coded program for Section "B" pages 83 to 87 inclusive are to be substituted for pages 82 and 87 inclusive of the original Earthwork Program. This substitution, in combination with the remaining part of the original coded program, will give the complete coded program for this problem.

The only difference in operational procedures for this program from those given in the original Earthwork Manual are those concerning Preparation of Ground Cross Section Tape.

ANALYSIS OF RECTANGULAR REINFORCED CONDRETE COLUMNS

Definition of the Problem:

The problem is to determine the maximum concrete and steel stresses in a rectangular or square reinforced concrete column subjected to axial load and one way or two way bending.

Specifications:

Input in floating point.

width of column - side parallel to x axis

width of column - side parallel to y axis

ratio of Es/Ec

axial load

eccentricity of axial load in x direction = Myy

eccentricity of axial load in y direction = Mxx

bar size number from #2 to #11

number of bar spaces in first row parallel to x axis

distance to x axis from first row parallel to x axis

number of bar spaces in first row parallel to y axis

distance to y axis from first row parallel to y axis

number of bar spaces in second row parallel to x axis

distance to x axis from second row parallel to x axis

number of bar spaces in second row parallel to y axis

distance to y axis from second row parallel to y axis

number of bar spaces in third row parallel to x axis

distance to x axis from third row parallel to x axis number of bar spaces in third row parallel to y axis

distance to y axis from third row parallel to y axis

Note: If there is only one row of bar all around input, the program will stop at D_2 ; for two rows it will stop at D_h . e_x and e_v should always be positive.

Mathematical Method Used:

Basic Approach - Successive approximation

Basic Equations:

$$S = \frac{P}{A} \pm \frac{Mxx}{Ixx} \pm \frac{Myy}{Ixx} x$$

$$S = \frac{P}{A} \pm \left(\frac{Mxx - \frac{Ixy}{Iyy} Myy}{Ixx - \frac{(Ixy)^2}{Iyy}} \right) y \pm \left(\frac{\frac{Ixy}{Iyy} - \frac{Ixx}{Ixx} Mxx}{Iyy - \frac{(Ixy)^2}{Ixx}} \right) x$$

PIER DESIGN MOMENT COMPUTATIONS FOR CONCENTRATED VERTICAL LOADS Program No. S-1

1. PROBLEM DESCRIPTION

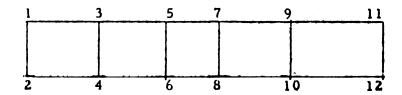
The program computes (by moment distribution) all final moments at each joint of a bent subjected to any number of concentrated vertical loads whose magnitudes and positions are given. Carry-over factors throughout are assumed to be one-half. The balancing and carry-over cycle is repeated six times for each load placed on the structure.

The information required is as follows:

- 1) The span lengths and the number of spans
- 2) The distribution factors
- The magnitudes and positions of the loads and the spans on which they are applied

Any units may be employed as long as they are consistently used throughout the problem. The joints are numbered from left to right as shown in the figure.

The output, as well as the distribution factors, follow this order of numerotation.



2. PROGRAM LIMITATIONS

- a) Corrections for sidesway due to dissymetry of loading or bent are not included
- b) Carry-over factors of one-half are used throughout
- c) Structure must be a single story rigid frame with prismatic members having a maximum of five spans.

INFLUENCE LINE FOR CONTINUOUS BEAM DESIGN

Definition of the Problem:

The problem is to calculate influence ordinates for moment at interior supports and for reaction at all supports of a four-span continuous beam. Each span is divided into ten equal panels.

Output:

(1) Influence Ordinates at all panel points and supports for moment at interior supports 10, 20 and 30. Results are typed out in 3 columns, respectively, (2) Influence Ordinates at all panel points and supports for reaction at all supports C, 10, 20, 30, and 40. Results are typed out in 5 columns respectively. Positive, negative, and net area of influence line are also typed out.

Mathematical Method:

- a. Conjugate beam method is used to calculate deflection at panel points and slope at supports for each span due to unit moment at support.
- b. By means of continuity at supports and Maxwell's Reciprocal Theorem, relation of moments at supports and slopes at supports due to unit load in a span is set up in terms of a matrix.
- c. Moments at supports are solved by matrix inversion and multiplication.
- d. Reactions at all supports are solved by statics.

USERS' PROJECT NO. 26

VERTICAL ALIGNMENT PROGRAM

I

VERTICAL ALIGNMENT PROBLEM DEFINED

GIVEN the following quantities:

- 1. Gradients; G₁, G₂, G_n
- 2. Vertical curve lenghts; L1, L2, Ln
- 3. P. I. Stations; P₁, P₂, P_n
- 4. Elevations of P. I. Stations; E₁, E₂, E_n
- 5. Required Stations; Sr1, Sr2, Srn
- 6. Initial Station; So
- 7. Initial Elevation; E
- 8. Increment to increase station; i
- 9. Distance from initial station to starting station, x
- 10. Limiting station; Se

IT IS REQUIRED TO FIND:

- 1. The tangent elevations; Et1, Et2, ... Etn
- 2. The correction factors; c_1 , c_2 , c_3
- 3. The vertical curve elevations; Ec1, Ec2, Ecn

NOTE: This is essentially the same program as <u>Users' Project No. 25</u>, but it has been converted to G-15D machine language.

JOB COST COMPUTATION

1. Definition of Problem: to facilitate the handling of random job cost data; to compute individual job hours and cost as well as total hours and cost.

2. Specifications:

a. Input - fixed point in following format:

DD.DDw tab s (Wage is entered in dollars and cents to a maximum of \$99.99 per hour.)

DDD tab s (Job number - 0 through 399)

DDD tab s (Hours to a maximum of 999)

Preceeding zeros are not needed in any of the above entries.

Once a wage has been entered, it is not necessary to reenter it until a wage change is desired, i.e., the format can become: job number, hours; job number, hours, etc. When a new wage is entered, it must follow an hour entry.

- b. Limitations: the present version is limited to 400 jobs, but could be extended to handle 700 jobs if necessary. The total cost capacity is \$99,999.99, but could easily be raised if needed.
- c. Accuracy: All output exact to least significant figure.
- d. Output:

Job No.	Hours	Co	st
0	Total hours worked	job O Total	cost job 0
l	Total hours worked	job 1 Total	cost job 1
2		2	2
•		•	•
•		•	•
•		•	•
399	,	job 399	j ob 399

Grand Total of hours Total cost all jobs

USERS' PROJECT NO. 28

RETAINING WALL DESIGN

This problem concerns cantilever retaining wall with the surcharge. The program computes maximum and minimum soil pressures, factors of safety against sliding, and the steel required (both area and perimeter) for the stem and the base:

ABSTRACT

Users Project #29

PIPELINE PROBLEM

(a) The Problem

The problem is:

- (i) To calculate the pressures at, and the amounts of gas flowing into and out of, all stations in a pipeline.
- (ii) Also to calculate the horsepower required, the compression ratio used and the amount of gas consumed for station use at all pumping stations on the pipeline.

(b) <u>Data Given</u>

Volume of sales at each station in M.M.cF/d.
Distance between stations in miles
Pipe constant depending on the pipe size.
Installed horsepower of pumping station.
Station useage factor. This is a constant covering all gas used by a station except for that used in running the compressors in M.M.cF/d.
Maximum pressure allowable at any station in PSIA.
Optimum compression ratio for each compressor.

(c) Program Restrictions

This program takes into account three types of stations;

- 1) Sales stations
- 2) Reciprocating pumping stations.) with or without
- 3) Centrifugal pumping stations.) sales.

All stations are computed, but print out may be suppressed for any station if desired.

USERS' PROJECT NO. 30

MICHIGAN EARTHWORK COMPUTATIONS

PROBLEM STATEMENT

at the volume of earth cut to be removed and the volume of earth fill to be placed between succeding sections dependent upon the ditch section routines called for on right and left sides of the road section. Other quantities namely, Station, Plan Grade, Areas, Summation of Volumes, Mass Ordinate, and Slope Stake Points are also part of the typeout. The basic data for the computation being the height of instrument, distances and rod readings to represent the existing ground section and the coordinates of road points based upon an axis of plan grade and construction centerline to represent the grading section.

LINEAR REGRESSION AMALYSIS OF DATA

Problem: Given data consisting of a constant, D, and up to 100 simultaneous measurements of two variables, L and t, fit these data by least-squares method to the equation

$$Y = a + b \cdot x$$
, where $X = L/D$ and $Y = log_{10}(60t)$.

Assume that errors of measurement in Y are larger than the errors of measurement in X.

Equations:

Let X_i and Y_i refer to the ith data point. The desired results may then be obtained according to the following equations:

 $X = \frac{1}{N} \sum X_i$ and $\overline{Y} = \frac{1}{N} \sum Y_i$, where N = the number of data points.

$$x_i = X_i - \overline{X}$$
 and $y_i = Y_i - \overline{Y}$

$$x_i = X_i - X$$
 and $y_i = Y_i - Y$
slope of the required least-squares line = $b = \sum x_i \cdot y_i - \sum x_i^2$

intercept of least-squares line = $a = \overline{Y} - b \cdot \overline{X}$

Sum of residuals =
$$\Sigma d_i = \Sigma(Y_i - a - b \cdot X_i)$$

residual variance, method 1, =
$$S_1^2 = \frac{\sum (Y_i - a - b \cdot X_i)^2}{N - 2}$$

residual variance, method 2, =
$$S_1^2 = \sum_{i=1}^{y^2} - b^{\circ} \sum_{i=1}^{y} x_i \cdot y_i$$

variance in b =
$$S_2^2/\sum x_i^2 = S_b^2$$

variance in a =
$$S_2^2(\frac{1}{N} + \frac{\bar{X}^2}{\sum x_i^2}) = S_a^2$$

probable error in
$$b = P_b = 0.6745$$
°S_b

probable error in a =
$$P_a = 0.6745 \cdot S_a$$

$$x^{mth}$$

Using the Taylor Expansion:

$$X^{m} = a^{m} + m \left(\frac{x-a}{a}\right) a^{m} + \frac{m(m-1)}{2} \left(\frac{x-a}{a}\right)^{2} a^{m} + \cdots + \frac{m(m-1)\cdots(m-n+1)}{n!} \left(\frac{x-a}{a}\right)^{n} a^{m}$$

Users' Project No. 33

DETERMINANT EVALUATION

Problem: Given an N x N determinant (N \leq 20), find its value.

Method:

The square matrix is reduced to a triangular matrix (i.e., all elements below the main diagonal are reduced to zero) by the method described in Frazer, Duncan, and Collar, "Elementary Matrices," (1946), pp. 106-108. Briefly, this is an iterative procedure which involves a series of stages as illustrated here for a 4 x 4 matrix:

all	a ₁₂	^a 13	allı	^a ll	a ₁₂	^a 13	^a l4	a ₁₁	^a 12	^a 13	a 114
a ₂₁	a 22	a ₂₃	^a 24	0	b	b ₁₂	^b 13	0	pII	b ₁₂	^b 13
^a 31	a ₃₂	a33	a ₃₄ >	-0	b ₂₁	b ₂₂	b ₂₃	-0	0	cll	c ₁₂
alul	a ₄₂	a ₄₃	alili	0	b ₃₁	b ₃₂	^b 33	0	0	c ₂₁	c ₂₂
The '	value	= a ₁ .	1°b11°c11°d	ıı•							
Successive stages are obtained using the							a	a ₁₂ ¥	^a 13	a 14	
relationships (from equations for matrix multiplications):						0	pII	b ₁₂	^b 13		
h .			a _{1+1,1}					0	0	c ₁₁	c ₁₂
bij '	- ^a i+:	1,j+1	a _{ll}	1,j+1	j			0	0	0	dıı
C., '	= b _{i+} ;	1 .447	- bi+1,1 · b	1 447.	; etc.	•					
77		ــ∓نويــ	р <mark>11</mark> -		-						

DETERMINANT EVALUATION

Provision is made for handling zero elements in the original matrix. A zero row or a zero column leads to a zero value. Other zeros are eliminated if necessary by adding rows or columns.

Data Input: The elements of the determinant are stored by columns in locations starting in 464, 484, 504, etc., as follows:

465	485	505	525	545	•••••	
•	•	•	•	•		•
•	•	•	•	•		•
483	503	523	543	563	•••••	દેઇંટ

If the determinant is smaller than 20 x 20, it is stored in the upper left-hand corner of this array of interpretive locations — i.e., the first column starts in 464, the second column in 484, etc.

Name: DETERMINANT PRINT-OUT Subroutine

Problem: Given an N x N determinant (N \$20), type out N rows of N columns.

Data Input: The elements of the determinant are stored by columns in locations starting in 464, 484, 504, etc., as follows:

845	• • • • • • •	545	525	505	485	465
•		•	۰	•	•	0
۰		•	•	•	٠	•
863		563	5 4 3	。 523	503	483

If the determinant is smaller than 20 x 20, it is stored in the upper left-hand corner of this array of interpretive locations -- i.e., the first column starts in 464, the second column in 484, etc.

The value of N, expressed as a floating-decimal number, is sent to the A register before the subroutine is entered.

Data Output:

A type-out is produced of the contents of the locations occupied by the N \times N determinant or matrix, with a carriage return between rows and a carriage return following the Nth row.

Remarks:

This subroutine may be stored in any 26 consecutive locations in the interpretive memory, starting with any locations from 000 thru 438. The location of the first order should be added to the address in each of the operations marked with an asterisk (*) on the coding sheet.

This subroutine uses index registers B_1 , D_1 , L_1 , B_2 , D_2 , L_2 , B_3 , and D_3 . All other index registers are not disturbed by the execution of this subroutine.

$$\frac{1-e^{-X}}{X}$$
 Subroutine

Problem:

At one point in solution of an equation, x is computed from other data and 1-e-x must then be computed.

Equations:

On p. 131 of "Approximations for Digital Computers" by Cecil Hastings, Jr. (Princeton University Press 1955) the following approximation for the above is given:

$$\frac{1-e^{-x}}{x} \approx \frac{a_1y + a_2y^2 + a_3y^3 + a_{11}y^{11}}{1 + b_1y + b_2y^2 + b_2y^3 + b_{11}y^{11}} \qquad 0 \le x \le \infty$$

where
$$y = \frac{1}{1 + px}$$

$$p = 0.2898,$$
 $a_1 = 0.2890,5386$ $b_1 = -2.2178,1431$
 $a_2 = 0.3324,0494$ $b_2 = 3.3313,1912$
 $a_3 = 0.4554,8498$ $b_3 = -1.6278,1495$
 $a_{11} = 0.5878,5466$ $b_{11} = 0.5143,1014$

USERS' PROJECT NO. 36

Present Worth Program $P = \frac{1}{(1+i)} n$

PROBLEM DESCRIPTION

Description: This is a program

This is a program that computes and tabulates a table according to the formula,

$$P = \frac{1}{(1+i)}n$$

where:

P

= Present worth of a unit value

i = Interest rate

n = Number of periods at interest rate "i"

Part III

METHOD OF OPERATION

Method of operation: The routine is self loading and is stored and executed from Line 02. The program also uses Lines 20 and 23.

The program is loaded by striking the "p" key and as soon as reading stops the compute switch is put to "GO". This loads the program and the computer halts. Resetting the compute switch to "GO" starts the program. The computer goes into a loop with typing gated waiting for the quantity (1 + i) to be typed. (Only significant digits need be typed as scaling is automatic.) The (1 + i) typein is terminated by either a "TAB or "CR". Do not strike the "s" key! If the "s" key is used, then turn the compute switch off, typed enabled "Q", then put the compute switch to "GO". After (1 + i) has been typed, the computer goes into the same loop waiting for the value "n" "TAB" or "CR" to be typed. A carriage return occurs and the table is tabulated with the decimal properly placed the the values correct to seven significant figures. After computing "n" values the computer halts. The program is restarted by resetting the compute switch to "GO". The program may be restarted at any time by striking an enabled "f" and resetting the compute switch.

Remarks:

Because a decimal to binary integer, digit by digit conversion routine is used, up to nine decimal digits may be typed for (1 + i). Successive values of "p" are computed by dividing the previous answer by (1 + i). All internal arithmetic is done double precision to prevent roundoff error.

The only error stop is in case of overflow during a division. A bell rings and the computer halts.

USERS' PROJECT NO. 37

8 VARIABLE MULTIPLE LINEAR REGRESSION

I. INTRODUCTION

This program is mainly of historical interest, since larger and faster matrix-type routines are available for the Bendix G-15 computer.

II. PROBLEM STATEMENT

Given N sets of simultaneous measurements of up to eight variables, X_1 , X_2 , X_8 , find the coefficients b₁j which give the "best" fit by the least-squares method to the equation

$$x_1 = b_2 \cdot x_2 + b_3 \cdot x_3 + \dots + b_8 \cdot x_8 ,$$
 where $x_1 = x_1 - \overline{x}_1$.

HIGHWAY PAY QUALTITIES

Users' Project No. 38

ABSTRACT

The purpose of the program is to compute pay quantities of up to seven types of material moved in construction of a highway.

The data given include the original ground line points in terms of elevation and distance from a datum, template line of final road in terms of elevation and distances from the same datum, line of rock coordinates, line of spoil coordinates and the coordinates of the points of intersection of the template and other lines. The program computes the areas bounded by the above lines and accumulates them according to cut and fill considerations. The volumes and accumulated volumes between successive cross sections are also calculated.

Data input is by means of paper tapes prepared on a Flexowriter and output of areas, Volumes and accumulated volumes for the various materials is by typewriter.

KENNE . . . Hockessin, Delaware KENNETT COMPUTER CONSULTANTS, INC. CEdar 9-5663

USERS! PROJECT NO. 39

TITLE Data Tape Preparation Routine

I. INTRODUCTION

Many machine-language programs accept their input data from punched tape via the photo tape reader. The data tapes for such programs usually would be prepared on an off-line Flexowriter. However, it is also convenient to use a pre-punched data tape even when only the basic G-15-D computer is available. This routine accepts typed-in data and prepares a data tape, including leader between blocks, suitable for use as input to the G-15-D computer.

II. PROBLEM STATEMENT

Given a type-in of successive data entries, prepare a data tape containing these data, one entry per four-word segment, with not more than 26 segments per block of punched tape. Insert 4 inches of leader between blocks of data on the output tape.

III. COMPUTATIONAL APPROACH

Line 19 is first cleared, and a type-in state is initiated. The type-in is terminated either by striking the s key or by setting the "Ready" state following entry of the 26th segment, which is detected by the appearance of non-zero information in 19.u0-u3. Line 19 is then precessed to bring the first non-zero information into 19.u4-u7, and punched out, using the condensed (29-digit) format. Leader is punched before initiating each type-in. This procedure is repeated for each block of data.

IV. DIRECTIONS FOR USE

A. Specifications

Type: Service routine.

Equipment Required: G-15-D.

Mode of Operation: Logical.

Execution: From line 19 and line 00.

Entry: This routine is self-loading, with the first command in 19.00. After loading, it may be re-entered by transferring control to 00.00.

Bendix Radio

ABSTRACT U.P. #40-C

REVISED FUNCTIONAL SUB-ROUTINE PACKAGE FOR DAISY

The purpose of this revised package is to reduce materially the time consumed by DAISY in evaluating the basic functions. The following revised sub-routines are included:

001 Logartthms

002 Exponentials

003 Sine, Cosine

004 Arc Tangent.

All OP codes remain the same as in the original sub-routines, and all instructions regarding them remain valid, with one exception -- there is no restriction as to the appendix line in which they may be used.

Computation time has been reduced by doubling up on the loops, by use of fixed-point arithmetic, and by the use of more sophisticated methods wherever possible.

All constants used were computed on the G-15.

The sine-cosine routine showed complete accuracy to 12 decimal places at all points tested; the other routines, although usually good to 12 decimal places, may be off 1 or 2 points in the last digit.

No responsibility is assumed by the author or by Bendix Radio Division for any errors, mistakes, or misrepresentations that may occur during computations when using this program; furthermore, no responsibility is assumed by Bendix Computer Division for the correct reproduction of this program.

Music Routine

1. To demonstrate the program connect audic amplifier to ground and the Line 19 test point. A volume control before the first stage to prevent overloading is highly desirable. A simple R-C network at the input may be used to change the tone if desired.

Read in the tape (\underline{P}) , no number track. Sum of first block only is checked. Next fifteen blocks are read in automatically. Routine gates typing.

To use the demonstration selections included on this tape, after the routine has been loaded (all 16 blocks) and has gated typing, type in

-5 TAB / S

and the three selections will proceed automatically. Some noise, of course, will be encountered during read-in.

After the last selection has been played, routine will loop back to the first by reversing tape.

2. If, however, it is desired to enter a new tune the following codes are used:

0	Rest	8	A
1	Bo	9	B flat
2	C	u	В
3	D	v	C i
4	E	w	c#,
5	F	x	D'
6	₽	У	E'
7	G	z	F'

These are relative, not absolute pitch.

Title:

DESIGN OF CIRCULAR REINFORCED CONCRETE COLUMNS

Originator:

Alfred Benesch & Company

Address:

10 South Wabash Avenue, Chicago 3, Illinois

Mode:

Intercom 500X

Date:

February 28, 1961

This program determines the required steel area in circular reinforced concrete columns subjected to any combination of axial load and moment. It designs according to conventional elastic concepts, according to the 1957 AASHO 1.7.8(f), or according to the 1956 ACI 1109 formulae; uses (n-1) or (2n-1) on the compression steel; and defines a cracked section by strict elastic theory or the arbitrary AASHO or ACI limits; all are designer selected options.

Input includes the modular ratio "n", allowable compressive and tensile stresses in the steel, either the ultimate or allowable compressive stress in the concrete, and twenty or fewer sets of column diameters, steel ring diameters, stress factors, loads, and moments. When the ultimate compressive strength is specified, allowable stresses are computed by the AASHO or ACI formulae.

Output consists of one line of nine words for each loading condition, to wit: column diameter; area for 1% steel; load; moment; maximum concrete stress; minimum concrete stress in uncracked sections, maximum reinforcing compressive stress in cracked sections, or minimum tensile stress on tensile sections; maximum reinforcing compressive stress in uncracked sections or maximum tensile stress for cracked or tensile sections; neutral axis location; and required area of steel. The program locates cracked section neutral axes with an error of less than .007 of the column diameter and determines the required steel area within 0.031% of the column area over a steel range from 0.5 to 2.5%, within 0.063% from 2.5 to 4.5%, 0.125% from 4.5 to 6.5% or 0.25% from 6.5 to 8.5% for a relative accuracy generally within 2.5% of the theoretically required area.

The neutral axis of cracked sections is determined by successive approximation "loops" with each correction behing half of the previous one and the first being one-half of the steel ring radius from the centerline diameter. One-half percent steel is tried first; two percent increments are added until the control points are all understressed; thereafter the change is half the previous change until a total of eight steel percentages have been tried.

The program is limited to one ring of steel. Two or more rings can be approximated by adjusting the ring diameter and allowable steel stresses. It can be used to determine bearing pressures under circular plates.

Running time is one-half to two minutes for an uncracked section and seven to ten minutes for a cracked section.

The original Users Project No. 42 was written by Wilson & Co. of Salina, Kansas. Part of this revision is also theirs.

USERS' PROJECT NO. 43

Supplement I

Title: Analysis of Circular Reinforced Concrete Columns

Class: 2

Mode: Intercom 1000S

Originator: Palmer & Baker Engineers, Inc.

Date: November 6, 1958

The program, using stated loading conditions, calculates various stresses in a circular reinforced concrete column. The basic program is identical with U. P. 43, rewritten for use with Intercom 1000S, then extended to be internally modified with respect to the number of rings of reinforcing steel. To complete the package the Bendix Square Root Subroutine and Intercom 1000S has been added.

With the exception of automatic modification regarding the number of rings of reinforcement the program is bound to any limitations binding on U. P. #43.

Reference to descriptive material of U. P. #43 is necessary for compilation of the input.

The program occupies memory locations 0800 to 0835 inclusive and 0900 to 1431 inclusive.

Users' Project No. lih

FLOW IN OPEN CHANNELS Program No. W-1

The purpose of this program is two-fold. First, the program will compute the rate of discharge (Q) in c.f.s. of an open channel when the depth of flow is known. Second, the program will determine the necessary depth of flow for a given rate of discharge.

The information required is as follows:

- 1) B₁ = Width of channel bottom in feet
 2) x₁ }
 3) x₂ = side slopes of both sides of channel
 4) S = longitudinal slope in feet/ft.
 5) n = Manning roughness coefficient
 6) d = depth of flow (in feet) if Q is desired
- 7) Q = discharge (in c. f. s.) if depth is desired

TABLE GENERATOR

GIVEN

X = initial value of X,

 $\Delta X = increment of X,$

X = final value of X,

Yo = initial value of Y,

AY = increment of Y,

Y = final value of Y,

W = page width,

L = page length,

and a function Z(X,Y), compute Z for X_0 ($\triangle X$) X_{max} , Y_0 ($\triangle Y$) Y_{max} , and tabulate the results. Number each page of output and advance the paper between the pages.

CHRISTMAS DISPLAY PROGRAM

PROBLEM SPECIFICATIONS

TYPE: Complete program

Logical, single-precision MODE OF OPERATION:

Stored in Line 00 and executed from Line 00 STORAGE & EXECUTION:

Program is self-loading (i.e., transfers itself from LOADING & ENTRY: Line 19 to Line 00, transfers control to Line 00 with a breakpoint, and then loads input information into lines 01, 02, and 03), with first command in location 19.00 or 23.00.

After completing one complete display (24 lines of 87 digits each), EXIT: a halt is reached. If the COMPUTE switch is placed in OFF and returned to GO, three more blocks of input infor-

mation will be read from tape, and displayed by the program.

DATA INPUT: Locations 99, 98, 97, 06, 05, 04 of the input blocks are used for information to be displayed. The first input block contains the first 8 lines to be displayed. The second block contains the 9th through 16th lines, plus a format (+0400000) in location 03. The third and final block contains lines 17 through 24, plus a format (44

(+4400000) in location 03.

DATA OUTPUT: Information contained in the input lines is printed out in 24 consecutive lines of 87 digits each, with all zeros

suppressed.

USE OF MEMORY: This program uses Lines 00 through 03, Lines 19 through 23,

and registers MQ, ID, PN, and AR.

EXECUTION TIME: If Z = the total number of zeros which occur to the right

of the last non-zero digit in the same line, the execution

time is given by the expression

 $t (seconds) = 456 - 0.22 \cdot Z$

AREAS BY COORDINATES

Statement of Problem

It is required to compute the area of a closed polygon with known coordinates of each corner.

Description of Problem

All corners with known x and y coordinates of a closed polygon are arranged in sequence. Two values are computed, first the area of the polygon in square feet and second, the area expressed in acres.

The program is also designed to provide cumulative areas of consecutive polygons in both square feet and acres.

CALCULATION OF ARC LENGTH, SECTOR AREA AND TANGENT DISTANCE

Civen:

A central angle in degrees, minutes and seconds of a portion of a circle and the radius of the circle.

Compute:

- A. The length of arc subtended by the central angle.
- B. The area of the sector of the circle subtended by the central angle.
- C. The length of the lines perpendicular to the terminal radii of the sector.

Solution:

- A. Convert \triangle (central angle) in degrees, minutes and seconds (decimal) to radians (binary) and R (radius) to binary.
- B. Multiply & times R to obtain I. (arc length).
- C. Divide R by 2 and multiply by L to obtain A (sector area).
- D. Convert \triangle to Θ (parts of circle) and compute sine and cosine of Θ .
- E. Divide R by $1/2 \cos \theta$ and multiply R/2 cos θ by $1/2 \sin \theta$ to obtain T (tangent length).

COMPOSITE BEAM DESIGN

The following program is written in INTERCOM 101 with all input and output in floating point decimal notation.

This program will completely design a wide flange composite beam, interior or exterior, with any haunch condition. The program will also design built-up welded composite beams that are symmetrical about the centerline of span.

Given all cross section dimensions, the basic wide flange beam, top cover plate (if any), maximum allowable stresses and applied loads, the program will calculate all composite section properties, develop the necessary live and dead load moments, and find the stresses due to these maximum moments. If the bottom flange is overstressed, it will increment the bottom cover plate thickness, then recompute properties, moments and stresses. This procedure is repeated until a satisfactory stress is obtained.

The typed cutput for this program is as follows; final bottom coverplate thickness; all moments, stresses and section properties at midspan; the distance from the support to the cut-off point of the bottom and/or top cover plate; the moments, stresses and section properties at either or both of these cut-off points; vertical shear, shear connector spacing and horizontal shearing stresses at the support, midspan and two intermediate points; reactions due to all live and dead loads; dead load camber and the live load deflection ratio; and finally the volume of concrete and weight of steel in the section.

The time required for one beam design, including type-in, varies from 10 to 25 minutes depending on the number of cover plates, initial section inclusions and the location of the cut-off points.

INTERCOM 101 BX

Part I

INTRODUCTION

It became apparent with the increase in the number of problems of long machine time duration, that the addition of a magnetic tape dump operation code to the INTERCOM 101 Routine was desirable.

Part II

SPECIFICATIONS

The program was inserted in long lines 00 and 04 of the INTERCOM 101 Routine. This routine uses all short lines.

Part III

OPERATING INSTRUCTIONS

Type: Service Routine

Equipment Affected: G-15D and MTA-2

Execution: The routine is executed from lines 00 and 04.

Data Input: The entire INTERCOM 101 compiler is loaded into the computer.

Type in <u>qf abc 0 tab s</u>, where abc is the (decimal) location of the first command.

Type in 010000 tab s. This order will be converted and

stored in address abc.

Under the control of the INTERCOM 101 Interpreter this order (0X0000) will dump the entire drum (including the INTERCOM 101 Interpreter) to magnetic tape.

Data Output: Refer to the INTERCOM 101 BX Magnetic Tape Retriever (Users' Project No. 51) and the INTERCOM 101 BX Data Extractor (from magnetic tape) Routine (Users' Project No. 52).

MTA RETRIEVER

Part I

INTRODUCTION

The INTERCOM 101 BX MTA-2 Retriever was designed to reload the complete drum (INTERCOM 101 BX Interpreter and the Interpretive Memory) that had been dumped to magnetic tape by the magnetic tape dump operation code.

Part II

SPECIFICATIONS

The INTERCOM 101 BX MTA Retriever Routine uses long line O1 and all short lines.

Part III

OPERATING INSTRUCTIONS

Type: Service Routine

Equipment Affected: G-15 and MTA-2

Execution: Block .yl2963w executed from line Ol.

Data Input: Type "p" to read over the number track. Then type "p" and

- 1. Set the compute switch to GO if you desire to reload the INTERCOM 101 BX Interpreter and Interpretive memory and continue the program at the step following the dump to magnetic tape.
- 2. Set the compute switch to <u>Break Point</u>, and the Program will return to the control of the INTERCOM 101 BK Interpreter and instructions to the Interpreter may be issued.

DATA EXTRACTOR

Part I

INTRODUCTION

The INTERCOM 101 BX Data Extractor (from Magnetic Tape) Routine to be used in conjunction with the INTERCOM 101 BX Routine was designed to load the Interpretive INTERCOM 101 BX Memory from Magnetic Tape and to extract and type any desired data.

Part II

SPECIFICATIONS

Long Lines 00, 01, 02, 04, 06 and 07; Short Line 23 and Locations 20.01 and 21.01 as well as the arithmetic registers are used by this routine.

Part III

OPERATING INSTRUCTIONS

Type: Service Routine

Equipment Affected: G-15D and MTA-2

Mode of Operation: Not Applicable

Execution: Block .649x13u executed from line 00

Block -.0573yv6 executed from line 02

Block .lx73yv6 executed from line 04

Data Input: Type in p and the number track is read into the computer.

Type p and the loader is read into the computer. Set compute switch to "Go" and the rest of the routine will be read and stored in the memory. Control will be auto-

matically transferred to a gate type-in.

Type in hex the number of files from which you wish to extract data. (e.g. Type u tab s and data will be extracted from the next 10 files on the magnetic tape.)

INTERCOM 1000 Documentation Routine

Part I

INTRODUCTION

The INTERCOM 1000 Program Documentation Routine was designed to list all the commands of any INTERCOM 1000 Routine in a neat and orderly manner on standard INTERCOM Coding Sheets.

Part II

SPECIFICATIONS

Long lines 00, 01, 02, and 03; short lines 20, 21, 22, and 23 and the arithmetic registers are used.

Part III

OPERATING INSTRUCTIONS

Type: Service routine

Execution: Block .0178y3w is executed from L 00.

Block -.0096789 is executed from L Ol.

Block .24z216w is executed from L 02.

Block -. zw93245 is executed from L 03.

Data Input: The entire INTERCOM 1000 Program is loaded into Interpretive

Memory (Lines 10-18).

Type in: .SS.TT tab s - where SS is the (decimal) line and TT is the (decimal) location of the first command to be listed.

In <u>Breakpoint</u> operation, type \underline{f} ; take the compute switch off B/P; return compute switch to \overline{B}/P or GO and then type .SS.TT tab s.

Data Output:

K OP .SS .TT [±] in standard INTERCOM 1000 language followed by a carriage return.

The routine normally types .SS.TT tab (the location of the next command in sequence), unless in Breakpoint operation, or unless one of the following conditions exists, in which case a bell is rung and control transferred to 00.00.

USERS! PROJECT NO. 54

AREAS OF SECTOR AND SEGMENT

Statement of Problem

It is required to compute areas of sector and segment of a known circle in square feet and acres.

Description of Problem

The coordinates of the center of a circle, radius of the circle, location of an arc and length of the arc are given as known data.

First, the area of a triangle bounded by two radii and chord of the arc, and second, the area of a sector bounded by two radii and the arc are computed. Finally, the area of a segment bounded by the chord and arc is computed from the previous two areas.

REINFORCING STEEL TABULATION Program No S-2

The purpose of this program is to compute the weight of reinforcing bars in a reinforced concrete structure.

Weights of reinforcing bars can be determined for one to six component parts of a structure. (For example, a bridge with 2 abutments and 2 piers would be referred to as a structure of 4 component parts). The weight of steel for each bar mark for each component part of the structure is computed and typed and also the total weight for that bar mark. At the conclusion of the problem, the program types the accumulated weight of reinforcing bars in each component part of the structure and also the total weight of reinforcing bars in the entire structure.

SPIRAL CO-ORDINATES Program No. H-4

The information required is as follows:

- 1) $\frac{d_i}{d_0}$ offset distance from spiral along a radial line
- 3) $\Theta_s = \text{total spiral angle in degrees}$
- 4) $L_a = total length of spiral from T.S. to S.C.$
- 5) L = length of spiral arc from T.S. to any point on spiral for which co-ordinates are desired.

 The program can compute co-ordinates for up to 200 points on the spiral.

PAYROLL PROGRAM

The Payroll Program is set up to compute the following information for each employee:

Base Pay	(B)
Withholding Tax	(W.T.)
Social Security	(s.s.)
City Tax	(C.T.)
Net Pay Check	(P)

Expressed mathematically, the problem is:

$$(B) - (W.T.) - (S.S.) - (C.T.) = (P)$$

B, the Base Pay, is equal to the number of hours worked (a) Multiplied by the hourly pay rate (b): B = ab. Note b may not exceed \$9.99. W.T., the Federal Withholding Tax, is figured on the basis of the Income Tax Formula established by the U. S. Government as follows:

W.T. = (Base Pay - \$13n) 0.18 = (ab - \$13n) 0.18 where n = the number of dependents claimed by the employee. Note: n may not exceed 9.

S.S., the Social Security deduction is figured as follows:

$$SS = 0.0225$$
 (Base Pay) = 0.225 ab

C.T., the City Tax, is figured as follows:

The program, therefore, must solve the following problem:

$$ab - (ab-$13n) 0.18 - 0.0225 ab - t ab = P$$

Mechanical Division GENERAL MILLS, INC. 2003 East Hennepin Avenue Minneapolis 13, Minnesota

USERS PROJECT NO. 58

G-15D Flexo-Simulator Program

by Harvey J. Chiat

Instructions:

- 1. Hit "p" key with enable switch on.
- 2. Compute switch to go.
- 3. Wait for "Gate type" configuration.
- 4. Type information as you would on a Flexo-writer.
- 5. Hit "s" key.
- 6. Computer punches leader and input information in the condensed format. The computer will then halt.
- 7. To repeat, compute switch off and back to go, then to step 3.

Check Sum: 0050000

Date of Issue: December 6, 1957

INTERCOM 101 TEST ROUTINE

Part I

INTRODUCTION

The INTERCOM Test Routine for the G-15 computer was written by Mr. Dan Turner and Mr. Mike Blair of Humble Oil Company in FLIP language. This routine, however, can be used in conjunction with the existing G-15 INTERCOM 101A or INTERCOM 101D.

Part II

OPERATING INSTRUCTIONS

Before "reading in" the INTERCOM Test Routine into the computer, the INTERCOM 101 tape must be read in. Then the INTERCOM Test Routine magazine should be placed on the photo-reader and the routine read into the computer under the control of the interpreter. When the compute switch is put on "GO", the testing will commence, and in the event that a certain INTERCOM order is not obeyed correctly, a code number will be typed out on the typewriter.

The detailed instruction is as follows:

- l. Read in INTERCOM 101.
 - a. Normal loading procedure for compiler.
 - b. Read in interpreter (qfx tab s).
 - c. Remove INTERCOM 101 magazine.
- 2. Read in INTERCOM Test Routine.
 - a. Place the test routine on the photo-reader.
 - b. Load the test routine starting at location 000 (qf0009 tab s)
 - c. When the photo-reader stops, execute instructions starting at location 000 (qf000z tab s).
 - d. The test will commence, and in the event that a code number is typed on the typewriter, a certain section of the computer or the INTERCOM routine is not working properly, and reference should be made to the attached list of codes for isolating the trouble.

NOTE: Adhere to the operating instructions for the INTERCOM 101 routine.

EARTHWORK VOLUME CALCULATIONS FOR PRELIMINARY DESIGN

Problem Description:

The purpose of the program is to compute the cut or fill volumes at given intervals, the total cut and fill volumes, and the mass ordinate. The input information consists of the dimensions for a standard cross-section, the percent shrinkage desired, the stations at intervals and the depth of cut or fill at each station. When the depth of cut or fill is greater than the specified limit, the dimensions used for the standard cross-section will change.

Formulae Used:

Area = d(dx + B)

Volume =
$$\frac{A_n + A_{n+1}}{2} (S_{n+1} - S_n)(\frac{1}{100})(\frac{1}{27})(Shrinkage factor)$$

(Volume is computed in cubic yards).

Mass Ordinate = ∑ Volume

COMPOSITE HEAM FOR INTERIOR AND FASCIA STRINGERS

A composite beam with or without bottom cover plate for both interior and fascia stringers is designed according to present specifications.

The problem is computed in the following five main parts:

- A. Three stresses for interior stringer, with assumed properties of steel wide flange beam, and cover plate, for a given concrete slab.
 - 1. Compressive stress in steel
 - 2. Tensile stress in steel
 - 3. Compressive stress in concrete
- B. Length of cover plate, spacing of shear connectors, dead load deflection, allowable and actual live load deflections and total weight of steel, for interior stringer.
- C. Three stresses for rascia stringer, as in item A.
- D. Length of cover plate.
- E. Spacing of shear connectors, dead load deflection, allowable and actual live load deflections, with computed or full length cover plate, and total weight of steel for fascia stringer.

Users' Project 62

ANALYSIS OF VARIANCE, FACTORIAL EXPERIMENTS

Introduction:

The analysis of factorial experiments is performed by a means similar to the Yates Procedure for two-level experiments but is generalized here to include up to six levels, not necessarily the same for each factor, and up to seven factors. The maximum number of experimental results is limited to 432.

The complete set of means and mean squares each relating to one degree of freedom is calculated. Separately, based on the higher order interactions as an estimate of the error term, the significant contrasts, at a confidence level of 97.5%, are computed.

Problem Statement:

For a complete factorial experiment in which factor a is tested at J levels, factor b at K levels, etc., the means and mean squares corresponding to single degrees of freedom are calculated by use of N orthogonal sums of the form

$$Y_{i} = \sum_{j=0}^{(J-1)} \sum_{k=0}^{(K-1)} \sum_{l=0}^{(L-1)} \dots m_{jkl} x_{jkl}$$

where N is the total number of observations and i ranges from 1 to N, where $x_{jkl\cdots}$ represents the observed result with factor a at level j, and so forth, and where $m_{ijkl\cdots}$ are orthogonal coefficients.

The coefficients for orthogonal polynomials given by Fisher and Yates are used.

Finally, the means and mean squares are given by $Yi/\sum m^2$ and $Yi^2/\sum m^2$ respectively.

CA-1 READ SUBROUTINE WITH DECIMAL TO BINARY INTEGER CONVERSION

It is often desirable to use as input for the G-15D IHM cards that have been punched as output from other data reduction equipment, or punched for other data handling equipment where the punch format in the card does not lend itself to easy and convenient handling with the G-15D, CA-1 combination. This subroutine enables one to properly handle signs and digits, when the digits desired may or may not be parts of larger numbers and where adjacent words are separated by as little as two columns in the card. Up to eight words per card can be read, converted to binary and stored in Lines 21 and 22. This routine will handle one to nine decimal digits and sign, numbers to 268, 435, 455 in size, and will store them as separate machine words. The routine reads one card and then exits from the routine to allow for computation before the next card is read.

Because this routine uses the digit by digit conversion routine it can assemble and convert as a binary integer from one to mine decimal digits into one G-15 machine word without the use of extractors or shift operations. It can convert two digits per revolution. There must be a "Tab" punch in the read program control card at the end of each word, as the one bit precession caused by the "Tab" is the signal to the routine that the next digit to read in is part of a new word.

HARLEY, ELLINGTON & DAY, INC.
Architects and Engineers
Detroit, Michigan

TITLE Influence Line Ordinates for Moment of a Three-Span Continuous Girder

Sheet No. 1 of 8

Date Jan. 7, 1958

Made by W. CHAMS

Checked by BW

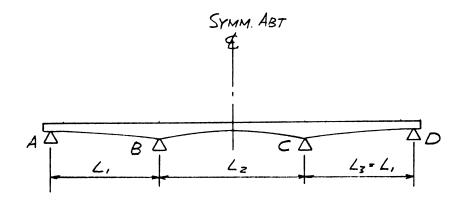
USERS' PROJECT NO. 64

1. DEFINITION

To calculate influence line ordinates for moment at tenth points of a three-span continuous girder with variable moment of inertia.

2. SPECIFICATION

a. Input: In floating point



SPIRAL CURVE COMPUTATION

Each Modified Spiral is predicated on conjoining a series of circular arcs of equal length whose successive radii are progressively decreased until the desired minimum radius is attained. A curve of this type differs from the conventional spiral in that the change is effected in finite steps at the end of the circular arcs rather than in constantly decreasing radii. For that reason, these curves are titled "Modified Spiral Curves" although the term "spiral" is used throughout the text.

These spirals were prepared to facilitate design layout and location in the field where design requirements necessitate gradual transition from tangent to the curve. For further information on these curves see:

Modified Spiral Curve Tables

рN

Department of the Army

Corps of Engineers

Office of the District Engineer

Los Angeles, California

June 1948

BUTTRESS DAM DESIGN

Abstract

The purpose of the Buttress Dam Design Program is to design a section which will satisfy the stress requirement at the heel of the dam, but not allow an overstress of the toe. The program allows an engineer to study the effect on total concrete volume of various heel slopes and buttonhead shapes. The program can also hendle prestressing forces applied to the heel of the dam.

Computation begins at a section (y_1h_t) depth down from the top of the dam. Superimposed moments and shears can be applied to the top section. The water is assumed to be as high as the top section. The length of the stem (2) is determined first from an estimate, then a convergence to obtain the limit heel stress. Newton's Method gives an adequate convergence in four cycles. Carry-down quantities are recorded and the computation proceeds to the next section (Δh) feet down. The toe stress is compared with the limiting value supplied and, when this is exceeded, the fan-out of the stem is computed. A simple two cycle convergence is employed to hold this toe stress to the allowable.

A flexibility of the program is provided by an allowance to select the critical loading condition either with or without earthquake. The type-out of stresses at each section is for all three conditions:

- (1) Masonry
- (2) Masonry, Hydrostatic and Uplift
- (3) Masonry, Hydrostatic, Uplift and Earthquake

The program is written for Bendix G-15D in Intercom 101D and requires three minutes to design each section.

WILSON ECOMPANY ENGINEERS (

P. O. BOX 28 SALINA, KANSAS 705 E. CRAWFORD AVE. TELEPHONE 7-4407

HORIZONTAL CURVE PROGRAM

Daisy 201

Definition of Problem.

This program will compute the radius, tangent, length, length of curve, external distance, P.C. Station and P.T. Station when the \triangle angle, the degree of curve and P.I. Station are known.

Application.

Program includes both arc and chord definition curves.

Limitations.

Program is limited to mineteen curves at one time and all must be either arc definition or chord definition.

Input.

- P.I. Station
- △ Central Angle
- D Degree of Curve

Output.

Fixed-point, Double Precision

- P.I. Station
- △ . Central Angle
- D Degree of Curve
- R Radius of Curve
- T Length of Tangent
- L Length of Curve
- E External Distance
- P.C. Station
- P.T. Station



P. O. BOX 28 SALINA, KANSAS

631 E. CRAWFORD AVE. TELEPHONE 7-4407

COMPUTATION OF PILE LOADS

Application

The purpose of this program is to determine the load on given piles of a group due to any combination of direct load and moment.

Input

Relative locations of piles in the group are entered as coordinates in a rectangular coordinate system. There may be up to 49 rows parallel to each axis. The pattern of the piles need not be symmetrical with respect to any axis.

The location of the direct load is entered as coordinates in the same rectangular coordinate system. The direct load need not be located at the center of gravity of the pile group. The moment due to any eccentricity is taken into account in the computations.

Additional moment is entered separately.

Limitations

No special consideration is given to battered piles. Negative loads indicate uplift.

WILSON ECOMPANY ENGINEERS & ARCHITECTS

P. O. BOX 28 Salina, Kansas

765 E. GRAWFORD AVE. TELEPHONE 7-4467

BEAM DEFLECTIONS

Intercom 101

Application.

Computation of the tenth-point deflections for one simple or continuous beam.

Input.

- Moments: 1. If loading is nonuniform, enter all end and tenth-point moments.
 - 2. If loading is uniform, enter only end moments and uniform load.

Moments of Inertia:

- 1. If I is irregular, enter all end and tenth-point moments of inertia.
- 2. If I is constant, enter only one I in first location, followed by a negative number.
- 3. If the beam has a I, T or rectangular section, enter constant section geometry and varying depths at end and tenth-points. The machine will compute moments of inertia. Span length and modulus of elasticity must be entered in all cases. Maximum word input 29, minimum 6.

Output.

Deflections in inches at ends (0) and tenth-points.

Abstract of Users Project No. 70-A Class 2

Title: Nth POINT BEAM DEFLECTIONS

Originator: Wilson & Company, Engineers & Architects

Address: 631 E. Crawford Avenue, Salina, Kansas

Mode: 500X

Date: August 1960

Application:

The computation by the Conjugate Beam Method of the deflections at n+1 equally spaced points on a supported or cantilever beam, where n is a number selected by the designer on the basis of number of deflections desired and accuracy required. Maximum $n = l_10$, suggested minimum l_10 .

Simple beam moment computations are available for uniform load, up to twenty concentrated loads, and the weight of the beam itself if it has geometry that can be described as all or part of an "I" in section and either straight or parabolically haunched in elevation (as in U. P. #70). End moments must be provided by the designer and entered as input data. Additional nth point moments may be provided by the designer for inclusion by the machine in the "M/EI Diagram."

Beam characteristics may be provided by entering the constant moment of inertia for a prismatic beam, the beam geometry for a beam as described above, or all nth point moments of inertia for an irregular beam.

The normal output is four columns: 1) an nth point index number, 2) the deflection in inches, 3) the deflection in feet and, 4) the moment in foot kips. In addition, for a beam defined by geometry (see above), the depths in inches and the moments of inertia in inches may be typed out as columns 5) and 6) at the designers option.

No auxiliary equipment is required. The running time varies from about three minutes for a ten point uniformly loaded prismatic beam to upwards of half an hour for a forty point haunched "I" section with a complex-system of loading.

USERS' PROJECT NO. 71

CA-1 TEST II

This program provides a test of the punching and reading of the CA-1.

The four words

1234567 -7654321 uvw0xyz -zyxowvu

are punched on each of fifteen cards. The cards are then read, and the input from each card is checked. An error causes all four words read from that card to be typed out.

CARD TO PAPER TAPE CONVERSION

1. Statement of Problem

To convert single-precision, fixed-point decimal data punched on cards to single-precision, fixed-point hexadecimal data punched on tape.

2. Numerical Method

Usual conversion procedure employed by input-output subroutine.

3. References

None

4. Additional Programs and Equipment Required

The routine uses the CA-1 card-reading attachment.

The input-output subroutine is used as a subroutine of UO13, and must be stored in line O2. This subroutine is the first block on the program tape.

5. Check Sums

LO2 1101000 LO0 6xx3352

USERS' PROJECT NO. 73

TYPE TWO-WORD REGISTERS

1. Statement of Problem

This program provides a convenient means of typing out the contents of the two-word registers during code-checking.

2. Numerical Method

None.

DECIMAL TO BINARY CONVERSION ROUTINE

Given x (decimal, fixed point, double precision) to convert to X (binary, fixed point, double precision) as an integer or fraction.

I (binary integer) = $D_{13} \times 10^{13} + D_{12} \times 10^{12} + ... + D_{1} \times 10 + D_{0}$

where X (decimal integer) = $D_{13}D_{12}$... $D_{1}D_{0}$ and powers of 10 are suitably scaled, within the computer.

X (binary fraction) = X (binary integer) : 10^{1h} 2⁻⁵⁷ Error Analysis

10ⁿ 2^{-r} is exact

Dn is exact

Accuracy is that of original data.

WEIGHTED MOVING AVERAGES

Given

[w₁] = address of first weight
[f₁] = address of first operand
[F₁] = address of first result
[a] = address of denominator
* 1 = increment to [F₁]
* m = increment to [f₁] (i.e., to give first operand for each F)
* k = increment to [f_i]

the routine calculates

$$F_{1} = \frac{1}{a}(w_{1}f_{1} + w_{2}f_{2} + \dots + w_{n}f_{n})$$

$$F_{2} = \frac{1}{a}(w_{1}f_{m+1} + w_{2}f_{m+2} + \dots + w_{n}f_{m+n})$$

$$\vdots$$

$$F_{N} = \frac{1}{a}(w_{1}f_{(N-1)m+1} + \dots + w_{n}f_{(N-1)m+n})$$

 w_1 , w_2 , . . . w_n , a must be stored in sequence within the computer.

* This increment must be an increment to the word time only; data cannot be extracted from several lines using this routine.

A running sum of $w_i f_j$ is kept in the computer, and the division is performed at the end of the calculation

Round-off error = $\frac{n}{2} \times 2^{-2\delta}$

SINGLE PRECISION FLOATING POINT PACKAGE

Available Operations:

Conversion: - Decimal to Binary and Binary to Decimal in floating

Point and integer fixed point.

Arithmetic:- Add, subtract, multiply, divide, square root

Storage Locations:-

Line 06: Add, subtract, multiply, divide

Line 07: Square root, fixed point conversion

Line C8,

09,

10: Floating point conversion

Command

Line Ol: Temporary storage

There are two basic packages in the system, the arithmetic package and the conversion package, which are controlled by Line 06. The arithmetic package may be used alone if required.

The routines are made operative by transferring the Control Line (06) to Line Ol. Thereafter, unless Line Ol is used for some other purpose, it will contain the control routine after the execution of any subroutine in the package. Entry to any subroutine is made through line Ol and return commands are executed from the AR at word time 99. The result of the subroutine is placed in 21.01.

Abstract Z012

Given measured SHORAN distances and flight and reference station data the map coordinates of aerial photographs are computed using the following equations:

i)
$$S_{A,B} = S' \times .99975 = C$$

11)
$$M_{A,B} = S - \frac{1.7935 (H-K)^2}{10^8 S} + \frac{0.24685 S^3}{10^{16} S^3} - \frac{1.6083 (H-K)^4}{10^{16} S^3}$$

iii)
$$K_{A.B} = K_0 (1 + K_1 q^2 + 0.00003q^4)$$

(1), ii), iii), iv) each computed with reference to each station)

$$V$$
) b = $\sqrt{(N_A - N_B)^2 + (E_A - E_B)^2}$

vi)
$$X = \frac{b^2 + r^2 - d^2}{2b}$$

vii)
$$Y = \frac{1}{2} \sqrt{r^2 - X^2}$$
 (the sign of Y is given for each flight)

viii)
$$N' = N_A = \frac{N_A - N_B}{b} X + \frac{E_A - E_B}{b} X$$

ix)
$$E' = E_A = \frac{E_A - E_B}{b} \times \frac{X + E_A - N_B}{b} Y$$

There is a final correction of a few metres to N', E' to give required northing and easting.

Notation: S' = measured SHORAN distance

C = given correction

q = distance from central meridian

Ko, K = given constants

NA, EA - northing and easting of easternmost station

 $N_{\rm B}$, $E_{\rm B}$ = northing and easting of westernmost station

H+K, H-K = altitude bounds for given flight.

STATE OF ILLINOIS

DIVISION OF HIGHWAYS

USERS' PROJECT NO. 78

Title: A subroutine for (1) conversion of degrees, minutes and seconds to degrees and fractional degrees, (2) conversion of degrees and fractional degrees to degrees, minutes and seconds.

Mode of Operation: Intercom 1000

General Statement: The subroutine will extract minutes and seconds, convert them to fractional degrees and add the fractional degrees to degrees, so that the result is in degrees and fractions of a degree. This permits the entering of degrees, minutes and seconds a one double precision word.

Example: 259°06'36.36" would be entered as 53.259063636 and converted to 259.10101°

The subroutine also converts degrees and fractional degrees to degrees, minutes and seconds for output.

Example: 320.54327102° would be converted and typed as 320.32357/5672 (fixed point).

Operation:

- (1) Enter subroutine at word location 1800 from marked transfer "one" with word containing degrees, minutes and seconds in "AA" and exit from 1845 with a return transfer "one".
- (2) Enter subroutine at word location 1847 from marked transfer with word containing degrees and fractional degrees in "AA", exit from 1886 with a return transfer "one"

In fixed point output, the decimal point sets off degrees. The two digits right of the decimal are minutes and the remainder is the seconds and fractional seconds.

Programming: J. L. Brown
Flow Diagrams: L. E. Davidson

RICHARDSON, GORDON AND ASSOCIATES

CONSULTING ENGINEERS

3 GATEWAY CENTER PITTSBURGH 22, PA.

3 PENN CENTER PLAZA PHILADELPHIA 2, PA.

PITTSBURGH

ABSTRACT - BEAM DEFLECTION PROGRAM

- Definition of Problem. To compute deflections at up to 11 equally spaced points (12 panels) and end slopes of a simply supported beam of constant or variable I due to combination of concentrated loads, uniform or uniformly varying loads, and end moments.
- 2. Input Data.
- E Modulus of Elasticity in ksi.
- L = Span length in feet.
- n Number of panels.
- P_i = Concentrated loads in kips. Up to 12 different concentrated loads may be entered.
- x_i Distance of load P_i from left support in feet.
- WI Uniform load at left support in kips/ft,
- WR Uniform load at right support.
- I_1 *=Moment of inertia in (in.)⁴. I_1 is moment of inertia between left support and first cover plate cut-off. For I +, I +, see sketch in write-up. Up to 12 moments of inertia may be entered.
- Yi = Distance from left support, to point where I_i ends, in feet. M_L = Moment at left support in ft. kips. Sign of moment must be entered.
- Ma Moment at right support.
- If it is a reinforced concrete beam, enter as many I, as n, the number of panels.
- 3. Output Format. Computer will type out end slopes and def ctions at panel points as specified by value of n in input.
- Mathematical Method. Newmark's numerical method and the sethed of conjugate beam are used.
- 5. Limitations. No more than one coverplate cut-off should occur within each subdivided panel.
- 6. Coding. In Intercom 101.

Part I

INTRODUCTION

The INTERCOM 101 Program Preparation Routine (101PPR) has been prepared to reduce the amount of machine time required for the initial preparation of an INTERCOM program.

The 101PPR performs the following:

- 1. The conversion of both orders and numbers from punched tape prepared on an off-line Flexowriter.
- 2. The documentation of the contents of the interpretive memory -- both orders and numbers. (This documentation routine has been issued previously as Users' Project No. 16.)

Part II

PREPARATION OF TAPE ON A FIFXOWRITER

- 1. (a) The conversion and storage of both numbers and orders commences with the location (abc) given in the instruction to 101PPR, and progresses through successively higher numbered locations until a word containing 0000000 is encountered. At this point the termination of conversion is announced by the ringing of the bell. (A word contains either an order or a number.) Each tape must contain only numbers or only orders it is not permissible to mix the two.
- (b) Line 19 is cleared by 101PPR prior to reading of the Flexowriter tape.
- (c) All words within a block of tape must be filled with other than 0000000, or premature termination of conversion will result. If the tape contains numbers, a zero may be punched on the Flexowriter as 1200000 or, as 5000000.
- (d) It is permissible to place 107 words on a block of tape which is prepared on a Flexowriter for conversion by 101PPR (the 108th word must then contain 0000000 to signal the completion of conversion of the block). However it is recommended that 100 words be placed on each block whenever possible. If this is done the contents of consecutive blocks of tape will then be (starting with INTERCOM Location 000):

BLOCK #1 000 - 099 (Inclusive)
BLOCK #2 100 - 199 (Inclusive)
BLOCK #3 200 - 299 (Inclusive)
and so forth.

USERS' PROJECT NO. 81

SIMULTANEOUS EQUATIONS SOLUTION

This is an Intercom 1000 program which solves up to nine simultaneous linear equations.

The constant terms and the coefficients of the unknowns are first stored in memory in matrix form.

The equations must be so arranged in the matrix that no zero coefficient falls on the principal diagonal.

The Gauss-Jordan Reduction procedure is then used to accomplish the following steps:

- Reduce the coefficients of all terms on the principal diagonal to unity and eliminate all terms below the principal diagonal.
- 2. Eliminate all terms above the principal diagonal, completing the solution.

The procedure for using the program is as follows, starting with the G-15D computer in the manual mode of Intercom 1000:

- 1. Read in the "Simultaneous Equations Solution"
 Program tape as follows:
 - a. The first block into Line ten.
 - b. The second block into Line eleven.
 - c. The third block into Line twelve.

DESIGN OF STEEL COLUMNS

The computer will pick up a section among 12" or 14" WF column sections and compute the stresses due to gravity loads, gravity loads plus x-direction wind or seismic forces, gravity loads plus y-direction wind or seismic forces, or gravity loads plus 45 degree wind or seismic forces if one of the stresses is greater than allowable. The computer will pick up the next larger section until all the stresses are within the allowable limit. After the computer finds the correct sections, it will type out column size, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads, moments about x and y axes due to gravity loads are gravity loads.

TAPE PREPARATION ROUTINE

Data type-in or read in on tape is processed in Line 19 and may be punched, typed, typed and punched, or typed and then punched. This program is complete.

AZIMUTH DETERMINATION FROM SUN OBSERVATION

The program determines the azimuth of a line from a set of 6 sun observations.

_ . _ .

Specifications:

- Input Data
 - 1. Latitude of point of observation
 - 2. The horizontal angle clockwise from sun to mark
 - 3. The apparent declination of the sun taken from an ephemeris
 - 4. The first and second corrections account of time to be added to apparent declination to give true declination of the sun at the time and place of observation and determined from the ephemeris
 - 5. The apparent altitude of the sun (90 degrees minus the vertical angle to the sun)
 - 6. Parallax and refraction corrections from the ephemeris
 - 7. The sun's semi-diameter from ephemeris

Output Results

- 1. The azimuth of the sun for each of 6 observations
- 2. The azimuth, station to mark, for each of 6 observations
- 3. The mean azimuth, station to mark, of all observations

Limitations

- 1. A set of 6 observations must be entered as input data. If fewer were taken they may be entered in duplicate or triplicate to complete the set.
- 2. Angles are entered in degrees, minutes and seconds and tenth of seconds as one floating point double precision word.
- 3. Output is in fixed point double precision, with one word containing degrees, minutes and seconds.

Subroutines Used

- 1. Conversion: degrees, minutes and seconds to degrees and fractional degrees, and degrees and fractional degrees to degrees, minutes and seconds
- 2. Sin, cosine and arc cosine

GRADES FOR AN INDEPENDENT DITCH OF REQUIRED STATIONS

This program is a supplement to the Michigan Earthwork Program.

The program will calculate elevations for independent ditches at regular stations (100' increments) and other desired odd stations.

CARD TO TAPE

This routine will read punched cards which have been punched with four seven digit words plus signs and will continue to read until a positive zero is encountered in the <u>first</u> word of a card.

After the card with the <u>first</u> word equal to zero has been read, the information will be punched on paper tape using the standard line 19 format

Then the punching of one block of tape is complete, the routine will again read cards and continue the cycle punching a 7.4 inch lead between blocks.

Tapes prepared with this routine are suitable as input for G-15D programs provided the cards are punched properly.

The routine is self-loading and is executed from command line 1 and uses line 06 for temporary storage.

Fourteen drum revolutions are allowed between each card reading to incure proper functioning of the 026.

SINGLE PRECISION FLEXOWRITER TAPE INPUT FOR DAISY

This program, when used as a DAISY appendix accepts single-precision, floating-point decimal tape input and converts it to double-precision floating-point binary for use with other DAISY functions.

Initial use of the program as a DAISY appendix causes one block of tape to be read into the computer. Up to 60 words may be stored in each tape block. The program takes the first number in the initial block, converts it to double-precision length floating-binary and stores this in the "A" register. Control is then transferred back to the next interpretive DAISY order. Subsequent use of this appendix will cause the second number in the first block read in to be converted and stored in the "A" register. When all of the numbers read in in the first block have been converted and stored and the appendix is again used, a second block of tape will be read and treated as above. Any number of fixed or variable length blocks may be read.

DE LEUW, CATHER & CO. ENGINEERS CHICAGO 6, ILL.

SUBJECT Computer program JOB NO. DC-56.
Curved Bridge Geometrics No. 1 sheet No. 1 .or. 1
MADE BY GF DATE 2-58 CHECKED BY DATE

Users' Project No. 88

Roadway Elevations for Bridges on Circular Curve

This program consists of two parts.

Part I computes the stations and offsets from the centerline of the roadway to stringers at centerline of piers and bearings; at division points of each stringer; for curved fascia stringer and/or curved construction joints and edge of bridge. Piers and stringers may be non-parallel. Gurves must be concentric. Entire span must be on curve. Output consisting of stations and offsets are punched on tape for use in part II of this program.

Part II computes the final top of roadway elevations for the points whose stations and offsets were computed from part I, including corrections due to vertical curve and superelevation if any. No transition of superelevation is considered. This portion of the program can be used independently of part I.

P. O. BOX 28 SALINA, KANSAS

631 E. CRAWFORD AVE. TELEPHONE 7-4407

VARIABLE DIMENSIONS OF ING-CENTERED CURVES

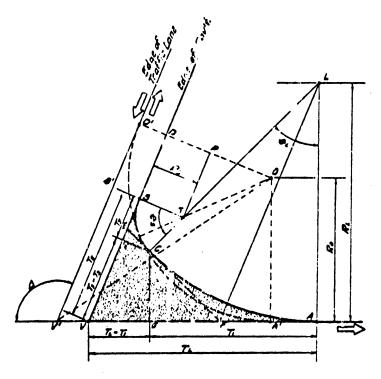
The use of a two-centered curve is desirable where single directional ramps connect with two directional roadways and the offside traffic enters into or exits from the ramp. Under the above conditions, the two-centered curve is preferable over the conventional single radius curve.

The combination of long and short radii for the respective angles of turn and the simple curve controlling radius should conform with the values given in the "Policy on Design of Rural Highways" by AASHO.

Particular reference is made to Chapter VII and to Tables VII 1 and VII 2.

This program will provide the control dimensions and area in square feet for two-centered curves with the minimum area of pavement.

Length of the curves is computed in case curbs are to be provided.



Input	Cutpuz
Ro	Δ
R _s R ₁	Τ _ς Τ _υ
DD'	T ₁ GC
85	T ₂
	CH A re e
	Length of Curb

SAT TRA WESSITA

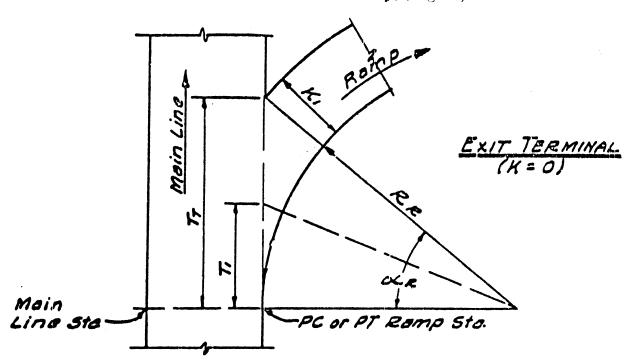
INTERCHANGE RAMP PROBLEM

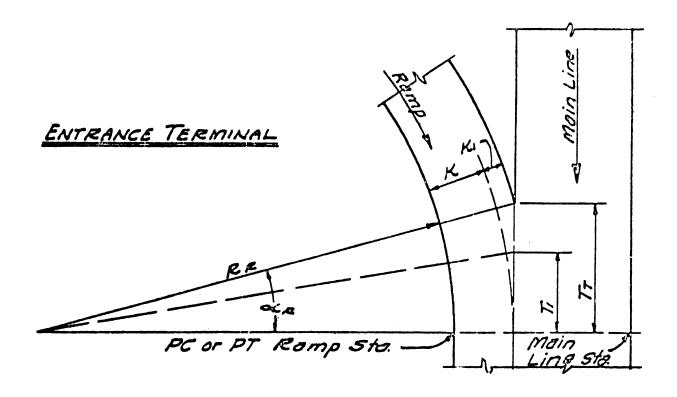
This program is coded for the Bendix G-15D in DAISY 201, using Angle Conversion Subroutine (on program tape) and the following DAISY Appendix: sine-cosine, fixed point typeout and arc tangent. Typeout is fixed point, double precision.

The program will compute ramp widths at the stations, + 25, + 50 and + 75 until the desired width has been reached. Also the Main Line Station at each of the computed widths. The 25-foot increment can be replaced with any desired increment. Input data includes the distance necessary to obtain the first desired ramp station.

The program is for five cases of ramps, consisting of tangents and simple curves. One case is shown on Page 2 of this abstract.

Users Project No. 90 (Page 2)





Usars' Project No. 91

3-SPAN CONTINUOUS BEAM BRIDGE MOMENT CALCULATION

This program is used to calculate the moments due to static and dynamic loading on a 3-span continuous beam bridge.

The bridge configuration is one which has 3 spans pinned at one support and on rollers at the other three supports. The continuous beam is assumed to have uniform loading (#/ft.) may be different for each span if desired. The span lengths do not have to be equal.

The dynamic loading is considered to be a truck having three axles; front (F), center (C) and rear (R). The distances between axles is entered as input data. Moments are calculated at every 1/50 point in each span for any one truck position on the bridge.

The program will automatically increment the truck's position so that the moments may be found as the truck "drives" across the bridge. The increment is set as input data and may be any fraction of a span desired. If the increment were set to 1/10 for example, the truck position would be incremented each time by 1/10 of the span in which the center axle is located.

The loading on each axle of the truck may be entered as input data.

For some obscure reason the truck is "driven" backwards from the left side of the bridge to the right. The center wheel is taken as the truck location.

SUM OF SQUARES AND CORRELATION COEFFICIENTS

ABSTRACT

Given N sets of observations on each of p variables where p < 25 and N < 1000, the ith set of which is represented by

$$X_{11}, X_{12}, \ldots, X_{1p}, i = 1, 2, \ldots M,$$

the program calculates and prints out

a) the column sums
$$A_{i} = \sum_{j=1}^{N} X_{ij}$$
, $i = 1, 2, ... p$

b) the sums of squares and bik =
$$\sum_{j=1}^{N} X_{ij} X_{kj}$$
, i,k = 1, 2, ..., p cross-products

d) the correlation
$$r_{ik} = \frac{c_{ik}}{c_{ii}}$$
 coefficients

Arithmetic is carried out in double-precision fixed-point and output is in double-precision except for the correlation coefficients which are typed out in single precision. Input may be by punched card, paper or magnetic tape and requires a special input subroutine which must be written for each particular problem.

MATRIX NORMALIZATION I

ABSTRACT

Given a matrix, A, not necessarily symmetric and of order p x N where p < 25 and N < 1000, this program computes and prints out the column sums and elements of the normalized matrix $A^{T}A$, where A^{T} is the transpose of A. The arithmetic is double-precision fixed-point and the output is double-precision. The matrix A is filled in one row at a time and processed. Input may be by punched cards, paper or magnetic tape and requires a special input subroutine which must be written for each particular problem.

DE LEUW, CATHER & COMPANY PROGRAM DC CE 4 TRAVERSE PROGRAM

TABLE OF RADII (ARC DEFINITION)

PURPOSE OF PROGRAM

The purpose of this program is to generate a table of Radii, $R = (100)(180)/\pi D$, and to demonstrate the flexibility of Intercom 1000D.

OPERATING PROCEDURE

1. Read in Intercom 1000D tape.

2. Replace Intercom tape with program tape.

3. Type 781000 (tab)/s.

4. When reading stops, type 591000- (tab)/s.

- 5. When reading stops and computer types back 18.00, type in the degree of curve desired (in degrees only) (tab)s. For example, if the radii are desired for each minute beginning with a 4 degree curve, type 4 (tab)s.
- 6. Then type 591000- (tab)/s. The computer will compute and type back all radii for curves beginning with the degree of curve originally selected plus the next 3 degrees of curve from zero minutes to 59 minutes.

7. To continue the program after a halt, type 241800 (tab)/s.

- 8. When computer types back 18.00, type in the new desired degree of curve.
- 9. Then type 591000- (tab)/s, and the computer will begin operation on the new datum.

The final results will be a table of radii similar to the given in Allen's "Railroad Curves & Earthwork".

ABSTRACT OF USERS PROJECT NO. 95 Rev. No.1

Title:

Two Span Influence Lines

Class:

Originator: De Leuw, Cather & Company

Date:

March, 1958

This program will calculate the influence line ordinates for reactions at supports and moments at every tenth point for a two-span continuous beam. In addition, it calculates the positive and negative areas under the influence curves for each span and the net total areas.

Four possible cases are considered:

- Constant moment of inertia, beam symmetrical about centerline Case I: Input data required are the panel length and moment of inertia.
- Case II: Constant moment of inertia, beam unsymmetrical about centerline Input data required are the two pairs of panel length and moment of inertia.
- Case III: Varying moment of inertia, beam symmetrical about centerline Input data required are the panel length and the ten average moments of inertia for each panel in the first span.
- Case IV: Varying moment of inertia, beam unsymmetrical about centerline Input data required are the two panel lengths and the average moments of inertia for each panel in both spans.
- For symmetrical beams, the output consists of: Influence line ordinates for reaction at exterior and center supports and the areas under the influence line curves for each span and the total net areas. Influence line ordinates for moments at p.p.l through 10 and the positive and negative areas under the influence line curves for each span and the total net areas.
- For unsymmetrical beams, the output consists of: Influence line ordinates for reaction at all three supports and the areas under the influence line curves for each span and the total net areas. Influence line ordinates for moment at p.p.l through 19 and the positive and negative area under the influence time curves for each span and the total net areas.

The conjugate beam principle and Newmark's numerical analysis method are used. Loading the M/I diagram on the conjugate beam, the deflection represents to some scale the influence line for reaction.

The total computation time is:

for symmetrical beams - 20 minutes for unsymmetrical beams - 30 minutes

Program tape needs not be read again for succeeding problems.

Users' Project No. 96

DE LEUW, CATHER & COMPANY PROGRAM DC CE 1 TRAVERSE PROGRAM

PURPOSE OF PROGRAM

The original intent of this program was to solve for the intersection of two straight, non-parallel lines, however, the program was expanded to check a complete traverse and if necessary, make a forced closure between the final point and the initial point of the traverse. The program will now solve any two unknown lengths in a traverse and type out these lengths in their proper locations, if the direction of these sides is known, or can be established by means of deflection angles. The program will convert deflection angles to azimuths in the process of computation and the final results will be typed out as coordinates, azimuths, lengths, latitudes and departures.

DE LEUW, CATHER & COMPANY PROGRAM DC CE 3 LOOP INTERCHANGE PROGRAM NO. 2

PURPOSE OF PROGRAM

The purpose of this program is to accept a predesigned interchange loop and to fit said interchange between two tangent readways. The program will also operate for an outer connection or to check alignment on a main line, and type out coordinates and stations of P.C.'s, P.I.'s, and P.T.'s. It will also compute and type out the curve data ordinarily required on the plans.

FORMULAE AND NOTATIONS USED:

Formulae:

If |cos Az, |is greater than |cos Az,

$$x = \underbrace{\text{Deps-}(\{ \text{Lats})(\tan Az_1)}_{\text{(cos Az_n)}(\tan Az_1) - \sin Az_n}$$

$$y = -\frac{x \cos Az_n + \xi \text{ Lats}}{\cos Az_1}$$

If |cos Azn|is greater than |cos Az1 |

y =
$$\frac{\text{EDeps-}(\text{ } \text{ } \text{Lats})(\text{tan } \text{Az}_n)}{\text{cos } \text{Az}_1 \text{ tan } \text{Az}_n \text{ -sin } \text{Az}_1}$$

$$x = \frac{x \cos Az_1 + \xi \cdot Lats}{\cos Az_n}$$

Notations:

∠ Deps - Sum of Departures

Lats - Sum of Latitudes

Azı = Initial Azimuth or Bearing
Azn = Final Azimuth or Bearing

Y - Closing Length along Initial Azimuth or Bearing

X - Closing Length along Final Azimuth or Bearing

Users' Project No. 98

Screed & Form Elevations

Program

prepared by Conseer, Townsend & Associates

Abstract of Report

This program is written in single precision with both input and output in floating point notation, using Intercom 103D.

There are three basic routines assimilated in this program: - (1) the computation of deflection of up to twenty four points in a single span of a continuous beam (2) the top of beam elevation at these points with the beam on a vertical curve or tangent (3) the depth of the beam. The program will combine the results of these routines to find the screed and form elevations. The beam may have haunches at either or both ends and they may be straight or parabolic haunches. The moments of inertia required for the solution of the beam deflection are computed from the following input data; the moments of inertia at each end of the beam, the minimum moment of inertia and the length of each haunch. At the time of data input, two numerical switches are set to give any of four output formats.

Format #1 Pt. No.	Dist.	Defl.	Sta.	Elev.	Screed Elev.	Mn.Depth	Form Elev.
Format #2 Pt. No.	Dist.	Defl.	Sta.	Elev.	Screed Elev.		
Format #3 Pt. No.	Dist.	Defl.	Ba. Dep	th			
Format #4							

The total operating time for Format #1 is approximately 30 seconds per point.

Pt. No.

Dist. .

Dofl.

USERS PROJECT NO. 99

ROUND OFF A POSITIVE FLOATING POINT NUMBER

PROBLEM STATEMENT

Required to round off a floating point number to obtain any set number of significant digits less than the complete word length.

For example, in an oil transfer problem, transfer information may be required to the nearest 1000 barrel-miles while the product of number of barrels times the number of miles produces a figure correct to the barrel-mile. The necessary round off may be accomplished using this subroutine.

COMPUTATIONAL APPROACH

The number to be rounded, N, is first divided by a round off factor R which inserts the decimal place at the round off point. For example, if N = number of barrel-miles, as discussed above, then R = 1000 to print out to the nearest 1000 barrel-miles. Note if a decimal fraction is to be rounded, R must be 10^{-a} where a is the number of places to the right of the decimal point at which round off is to occur.

This new number, N¹, is then divided by 10 "a" number of times until $\frac{N^{\bullet}}{10a}$ = N" < 10. "a" is stored as a counter to govern the

number of times the next loop is carried out.

The next loop consists of subtracting 1 from N" "b" number of times until N" - b < 1. A set of numbers $x_i = 0$, 1, 2 . . . 9 which has previously been stored in consecutive locations is then addressed using "b" to modify the address, thus picking out the digit of the number N" which was to the left of the decimal point. This is then added to working storage (2) which has previously been multiplied by 10.

This is then continued a number of times governed by the counter "a" until working storage (2) contains the number chopped at the decimal point. The remainder at this time is tested against 5 and one added to WS(2) if the remainder was greater than 5.

Thus WS(2) now will contain our rounded number.

NUMERICAL EXAMPLE

First Loop

$$\frac{N}{4728.2}$$
 $\frac{R}{100}$ $\frac{N!}{47.282}$ $\frac{N!}{4.7282}$ $\frac{a}{1}$

Title:

PIER ANALYSIS

Class:

2

Mode:

Intercom 1000 (T.M. 24A)

Originator:

Vogt, Ivers, Seaman & Associates

Date:

Sept. 25, 1958

The program described here is designed to operate as a succeeding step to the program PIER ANALYSIS (U.P. #100). With a few modifications the previous program will punch tapes of influence moments instead of typing them out.

SUPPLEMENT #1 will read these influence moments, multiply them by appropriate loads, and add them properly to obtain the actual moments at each joint due to (a) Distributed dead load (b) Concentrated dead loads (c) a set of Concentrated live loads (d) three or less horizontal forces (e) two temperature changes and (f) one shrinkage. Additional cases of live load can also be worked two at a time by re-running the program.

DATA: The data required for this program consists of (1) Concentrated dead loads (2) one set of live loads (3) three horizontal forces (4) two temperature changes (5) and one shrinkage (equivalent temperature drop).

If there are cantilevers, the dimensions of the cantilever are also required. The program computes the moments due to the cantilevers and adds these moments to the respective moments due to distributed dead load before type out. For concentrated loads on the cantilever, the data required are moments due to the loads and not the loads.

Output Format: The output format of this program is very similar to the one for the original PIER ANALYSIS program. The moments of the columns are typed out one below the other, the upper being the moment at the top of the column and the lower at the base of the column. The moments of the spans are typed side by side. On the left is the moment at the left end and on the right is the moment at the right end of the span. To recognize the case of loading giving the particular moments, there is a fixed point type out at the top, with an alphabetical prefix, the meanings of which are given below,

ul - Distributed dead load u2 - Concentrated dead load v1,v2,vn - Each set of concentrated live loads w1,w2,w3 - Horizontal forces x1, x2 - Temperature change y1 - Shrinkage

PROPLIM STATEMENT

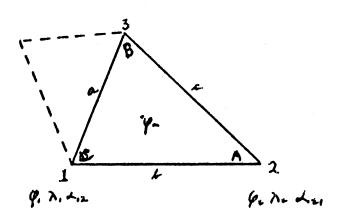
Given

- (1) A chain of triangles defining a triangulation on the earth's surface originating on a line of known length.
- (2) The lat. and long. of each end of this line.
- (3) The azimuths along the line at each end of this line.
- (4) The distance angles A and B of each triangle.

Compute

- (1) The trigonometric sine table and common difference for l' for the three angles of each triangle.
- (2) The Spherical Excess of each triangle.
- (3) The lengths of the two unknown sides of each triangle.
- (4) The closing error of the triangle.
- (5) The coordinates of the unknown point of each triangle.

MATHEMATICAL APPROACH



Users' Project No. 102

MAGNETIC TAPE WRITE/READ SUBROUTINE AND ROUTINE CALLER

The Magnetic Write/Read Subroutine provides for systematic recording of information onto magnetic tape and for its subsequent recall using one ETA-2 (as unit 4). It occupies one long line of memory (L.Ol). The Magnetic Routine Caller (in the same block) is a self-loading routine providing for read-in of any specified block stored on magnetic tape followed by a halt and transfer of control to 23.00.

DOUBLE PRECISION BINARY TO DECIMAL CONVERSION

1. Statement of Problem

Given X, (binary, fixed-point, double-precision) to convert to x (decimal, fixed point, double-precision) as a fraction and rearrange in a form convenient for output.

2. Numerical Method

The binary fraction X is multiplied successively by 10 x 2^{-4} .

3. Reference

None

4. Additional Programs and Equipment Required

None

5. Check Sums

-.U9603V2

6. Initial Data

X (decimal) in 1D (sign in 1P, absolute value in 1D). Return command in AR.

7. Storage

Program and constants stored in line 02.

8. Output

The converted number is stored in the PN as $d_1 \ d_2 \ ... \ d_7 \ S_1 \ d_8 \ d_9 \ ... \ d_{14} \ S_2$ where S_1 is the sign bit, S_2 is an extraneous bit and d_1 is a binary-coded decimal digit consisting of four bits. The sign bit is also stored in the lP.

The decimal number has been rearranged in this manner so that it may be typed out with the format SPDDDDDDD tab PDDDDDDD carr. retn.

9. Error Indications

None

10. Provisions for Setback

Restore input data. Re-enter subroutine.

USERS PROJECT NO. 104

EVALUATION OF A QUADRATIC FORM

1. Statement of Problem

Given a symmetric matrix K and a vector X both of rank n (\leq 10) to compute X'KX.

2. Numerical Method

Obvious.

Accuracy: the only errors introduced are round-off errors during multiplication and addition.

3. References

None

4. Additional Programs and Equipment Required

The arithmetic subroutine section of XOO5 - BCD Floating-Point Double-Precision S.R. is used.

5. Check Sums

L10 -.y7z3714 L06 -.yx9y533 L07 .uuy2285

6. Initial Data

All input data is stored within the computer. Return command in AR. The matrix $K \Rightarrow 14.02$ to 14.(02 + n(n+1) - 1) (max. 15.03) The vector $X \Rightarrow 15.50$ to 15.(50 + 2n - 1) $2n \Rightarrow 15.04$ as hex integers in the $n(n+1) - 2 \Rightarrow 15.05$ T-field.

7. Storage

The main routine is stored in L10 and I06. L10 must be read into L02 before entering it at word time 75. Program constants are also stored in L10 and L06. Subroutine X005 operates from L01 but must be left stored in L07. All of the short lines are used by this routine. L14 and L15 are used by initial, intermediate and final data.

8. Output

All output data is stored within the computer.

The vector
$$KX \rightarrow 15.08$$
 to $15.(08 + 2n - 1)$
 $X^{\dagger}KX \rightarrow 15.06$, 7

USERS' PROJECT NO. 105

P. T. PROGRAMS

This is a set of subroutines containing such facilities as, e.g. ring bell three seconds and type AR, special tape reader and input and storage, pick up line 22 from 16 word storage band, etc.

USERS' PROJECT NO. 106

MICHIGAN STATE HIGHWAY DEPARTMENT TRAVERSE CLOSURE PROBLEM

This program will solve for unknown distances and/or unknown bearing angles, if any, of a course, close the traverse and type out pertinent traverse data.

BESSEL FUNCTIONS OF THE FIRST KIND J (x) and J1 (x)

<u>PROBLEM</u>: To calculate the Bessel Functions J_0 (x) and J_1 (x).

METHOD: The methods used are those described in "Mathematical Tables and Other Aids to Computation", issue of April, 1957, page 86 ff. After some juggling and redefinition, the formulas become:

(for $x \le 4$)

$$J_{0}(\bar{x}) = c_{0} + c_{1}t^{2} + c_{2}t^{4} + c_{3}t^{6} + c_{4}t^{8} + c_{5}t^{10} + c_{6}t^{12} + c_{7}t^{14}$$

$$J_{1}(x) = c_{0}t + c_{1}t^{3} + c_{2}t^{5} + c_{3}t^{7} + c_{4}t^{9} + c_{5}t^{11} + c_{6}t^{13} + c_{7}t^{15}$$

where $t = x/\mu$, the values of c being different in the two formulas. Values of c are listed on the program sheet.

(for $x \ge 4$)

$$J_0(x) = 1/2 \sqrt{2t}$$
 $(P+Q)\cos x + (P-Q)\sin x$

$$J_1(x) = 1/2 \sqrt{2t}$$
 $(P+Q)\sin x - (P-Q)\cos x$

where
$$P = d_0 + d_1 t^2 + d_2 t^{1/4} + d_3 t^6 + d_1 t^8 + d_5 t^{10}$$

$$Q = e_0 t + e_1 t^3 + e_2 t^5 + e_3 t^7 + e_1 t^9 + e_5 t^{11}$$

 $t = \frac{1}{4}x$, and again the values of d and e being different for the two functions.

PROCEDURE: Main program must put x into the A register. For $J_0(x)$ enter at 500, and for $J_1(x)$, enter at 502. Sub-routine puts calculated function into the A Register. Negative numbers will be rejected by the program, which will cause the error signal to be given.

USERS PROJECT NO. 108

TITLE: BESSEL FUNCTIONS OF THE SECOND KIND Y_0 (x) and Y_1 (x)

The program calculates the Bessel Functions Y_0 (x) and Y_1 (x).

USERS PROJECT NO. 109

TITLE: CIRCUMFERENCE OF AN ELLIPSE, AND INCOMPLETE ELLIPTICAL INTEGRAL E (\emptyset, Θ)

The problem is: (1) given the semi-major axis (a) of an ellipse, and the semi-minor axis (b), to calculate the circumference; (2) given the amplitude (\emptyset) and the eccentric anomaly (Θ) to calculate the elliptical integral E (\emptyset , Θ) = $\int_0^\infty \sqrt{1 - \sin^2 \Theta \sin^2 \emptyset}$ d \emptyset

USERS PROJECT NO. 110

TITLE: ERF'(x), ERF(x), PROB'(x), AND PROB(x)

The problem is to calculate the error function or the probability

function to a greater degree of accuracy than that provided by the Erf

subroutine; it is also to provide a means of calculating the deriva
tives quickly.

USERS PROJECT NO. 111

TITLE: LOG (x!)

The problem is to calculate the natural logarithm of x!

Users' Project No. 112

J. E. GREINER COMPANY Baltimore, Maryland

Ground-line Tape Preparation Routine

Machine-language Program for G-15D

Class I

This program computes intermediate ground-line points at 100-foot interval: on two average cross-slopes from the section centerline given the centerline elevation and the offset to and elevation of one left and one right ground-line point beyond the respective slope stakes.

The program output is a ground-line data tape for Supplement No. 4 to User's Project No. 21 (Illinois Earthwork Program).

The program was developed for preliminary studies and handles no refinements such as superelevation, station equations, etc.

Areas of Polygon, Sector & Segment

Abstract

It is required to compute areas of (1) polygon, and (2) sector and segment of a known circle in square feet and acres.

The program consists of Parts I and II.

Part I: All corners with the x and y coordinates of a closed polygon are known. The area of a polygon and cumulative areas of consecutive polygons in both square feet and acres are computed.

Part II: The coordinates of the center of a circle, radius of the circle, location of an arc and length of the arc are given as known data. First, the area of a triangle bounded by two radii and chord of the arc is computed by Part I. Then, the area of a sector bounded by two radii and the area of a segment bounded by the chord and arc are computed.

An area will be determined to the nearest 0.001 square feet and 0.000 1 acre.

USERS' PROJECT NO. 115

Binary to Decimal and Decimal to Binary Subroutines
This is a fixed point, double precision subroutine.

FILL GIVEN LOCATION

1. Statement of Problem

To enter a given (hexadecimal) number in a given memory location.

2. Numerical Method

Dbvious.

3. References

None.

4. Additional Programs and Equipment Required

None.

5. Check Sum

.y78z2ul

6. Initial Data

To enter $\stackrel{+}{=} X_1 X_2 X_3 X_4 X_5 X_6 X_7$ in memory location ab:cd, type: abcd (tab) $\stackrel{+}{=} X_1 X_2 X_3 X_4 X_5 X_6 X_7$ (tab) s.

Note 00: ab = 28, ab \neq 27; 00 \(\) cd \(\) U7.

7. Storage

The program is stored and executed from Line 19.

All memory locations except ab:cd andline 19 are unaffected by the routine.

8. Output

None.

Note that the number $h = \frac{1}{2} X_1 X_2 X_3 X_4 X_5 X_6 X_7$ is stored that "1" characteristic so that if ab = 24, 25 or 26, the sign in the does not necessarily correspond to that of h.

9. Error Indications

If ab = 27, ab > 28 or cd > U7, the bell rings, and the number h is not stored. The contents of memory (except certain locations in line 19) are unchanged. The computer halts ready for another type-in.

USER' PROJECT NO. 117

TYPE SPECIFIED LOCATION

Statement of Problem

To type the contents in hexadecimal of a given location in memory.

Numerical Method

Obvious.

References

None.

Additional Program and Equipment Required

None.



COEFFICIENTS FOR A 4th DEGREE POLYNOMIAL O.O. Co. Project No. 1

Users' Project No. 118

Application

The purpose of this program is to fit a 4th degree polynomial to an empirical curve. The desired equation is:

 $Y = A + BX + CX^2 + DX^3 + EX^4$

Input

Seven equidistant values of X are selected and the corresponding values of Y determined from the curve. The seven values for Y, the first value for X and delta X are typed into the computer.

Output

The output consists of the seven selected values of X and Y, the coefficients A, B, C, D, E and calculated values of Y using the selected values and intermediate values for X.



RICHARDSON, GORDON AND ASSOCIATES

CONSULTING ENGINEERS

3 GATEWAY CENTER PITTSBURGH 22, PA.

3 PENN CUNTER PLAZA PHILADELPHIA 2. PA.

Users' Project No. 119

PITTSBURGH

ABSTRACT

SHEAR AND MOMENT INFLUENCE LINES FOR INTERMEDIATE PANELS BETWEEN SUPPORTS FOR CONTINUOUS BEAM DESIGN

1. Definition of Problem. To compute shear and moment influence line ordinate for 1/10 panels between supports for continuous beam with 3 or 4 spans. This is a continuation of the Moment and Reaction Influence Lines Program for 3 or 4 Span Continuous Beam Design submitted as Users' Project No. 24. From here on Moment and Reaction Influence Lines is called Part I, Shear and Moment Influence Lines for intermediate panels between supports is called Part II.

2. Input Data.

- \mathcal{L} = Panel lengths of 1st span in feet, 1/10 of span length.
- \mathcal{L}_{i} = Panel lengths of 2nd span in feet, 1/10 of span length.

This program should be run right after the completion of Part I. Data developed by Part I should still be on the drum. Reading of Part II will not disturb this data (to be used by Part II). If for some reason Part II cannot be run right after Part I, the values from Location 000 to 210 inclusive can be punched out at the end of Part I and read in later—just before running Part II.

3. Output Format.

- a. Influence ordinates at 1/10 points for shear in panel intervals are typed out in 10 columns for 1st span, then the same in 10 columns for 2nd span. Plus, minus and net areas of each Influence Line are also typed out
- b. Influence ordinates at 1/10 points for moment at intermediate panel points are typed out in 10 columns, then the same in 10 columns for 2nd span. Plus, minus and net areas of each Influence Line are also typed out.
- 4. Mathematical Method. Shear and moments for intermediate panels are calculated by statics based on known moment and reaction influence line ordinates at the supports.
- 5. Limitation.

GESRGE S. RICHARDSON

- a. Each span must be divided into 10 equal panels.
- b. Symmetrical spans are assumed so that Span 1 and 3 must be identical for 3 span continuous beam and Span 1 and 4, 2 and 3 must be identical for 4 span continuous beam. Symmetry is not required for Part I.
- o. Coding. In Intercom 101.

JAMES C. FISHER

LIMPS M. MOREHOUSE

RICHARDSON. GORDON AND ASSOCIATES

CONSULTING ENGINEERS

3 GATEWAY CENTER PITTSBURGH 22, PA.

3 PENN CENTER PLAZA PHILADELPHIA 2, PA.

Users' Project No. 120

PITTSBURGH

ABSTRACT - CANTILEVER BEAM DEFLECTION PROGRAM

- 1. Definition of Problem. To compute deflections at up to 12 equally spaced points (12 panels) of a cantilever beam of constant or variable I due to combination of concentrated loads, uniform or uniformly varying loads, and slope change at support end.
- Input Data.
- 0 Slope change at support end in radian.
- E = Modulus of Elasticity in ksi.
- L = Span length in feet.
- n Number of Panels.
- WL = Uniform load at left support in Kips/ft.
- W_R = Uniform load at right end in Kips/ft,
- I_1^* Moment of inertia in (in.)⁴. I_1 is moment of inertia between left support and first cover plate cut-off. For I_1+1 , I_1+2 , see sketch in write-up. Up to 12 moments of Inertia may be entered.
- Y_1 Distance from left support, to point where I_1 ends, in feet.
- P₁ = Concentrated loads in Kips. Up to 12 different concentrated loads may be entered.
- xi = Distance of load Pi from left support in feet.
- If it is a reinforced concrete beam, enter as may I, as n, the number of panels.
- 3. Output Format. Computer will type out deflections at panel points (as specified by value of n in input) in one column.
- Mathematical Method. Newmark's numerical method and the method of Conjugate Beam are used.
- Limitation. No more than one cover plate cut-off should occur within each subdivided panel.
- 6. Coding. In Intercom 101.

JAMES M. MOREHOUSE



INTERCO	M103-D	PROG	RAM	NO	NCP-2	PAGE	1	_OF_	6
TITLE	X-RAY	LINE	BRO	DENI	NG		*		

USERS' PROJECT NO. 121

I. INTRODUCTION

Although the determination of crystallite size from x-ray diffraction line broadening involves a relatively simple experimental procedure, the computations are somewhat laborious and tedious. When a large number of determinations is to be carried out, the probability of error in these repetitive calculations is greatly increased. With a tabulation of size as a function of experimentally measured parameters, the determination is greatly simplified, since computation is eliminated. The time required for the determination is also greatly reduced once the table is prepared.

II. PROBLEM STATEMENT

To generate a table of crystallite size in terms of parameters which can be measured directly.

KENNETT COMPUTER CONSULTANTS, INC. Hockessin, Delaware CEdar 9-5663 G-15 PROGRAM NO. 4200 LINEO,1,2,3,4 or 5 PAGE 1 OF 16 TITLE Magnetic Tape Control Appendix for Daisy - Appendix #32

USERS' PROJECT NO. 122

I. INTRODUCTION

This program, when used as a Daisy Appendix, will read and write blocks of 100 words to and from the Daisy memory. Block numbers desired and memory selection for the read and write functions are controlled by the setting of index register W.

II. PROBLEM STATEMENT

This program provides for three separate functions called initialize, read and write. They are described as follows:

Users' Project No. 123

AVERAGING DATA

This program is used to compute the arithmetic means of sets of positive numbers $y_{i,j}$ which represent individual measurements of a dependent variable y = f(x) for equally spaced values, x_i , of the argument x. Some of the $y_{i,j}$ can be missing.

Given data in the form

$$x_1$$
 y_{11} y_{12} \cdots y_{1n}

where
$$x = X + \Delta x$$
 ($\Delta x = constant$)

and where some y_{ij}'s are missing.

Compute
$$y_i = \frac{k}{n} \sum_{j=1}^{n_i} y_{ij}$$

where $n_{\underline{i}}$ is the number of existing values of $y_{\underline{i},\underline{j}}$ in line i.

Users' Project No. 124

DESIGN OF CHAMBEL L-MALL

ABSTRACT

Program completely designs wall and base slab; calculates moments; K-values and area of steel required per linear foot of structure at every foot of wall height and at every foot of slab length; thickness at base of wall and at heel of slab; diagonal shear; perimeter of steel required; soil pressure at heel and toe with prescribed depth of water in channel and with channel capty. Maximum height of wall must be not greater than 32 feet. Base slab equals wall height. Program handles conditions of level backfill to top of wall, or surcharge.

J. E. GREINER COMPANY Consulting Engineers Baltimore, Maryland

Users' Project No. 125

Coordinates of the Path of a Point on a Rolling Lift Bascule Leaf

Intercom 1000 Program for Bendix G-15D Computer

Problem Statement

Program Abstract

This program computes the coordinates of the path of any point on a rolling lift bascule leaf as the leaf moves through an arc of 75 degrees. Zero degrees is the fully closed bridge position.

Coordinates are computed as a function of angular motion of the leaf. Angles computed at one-degree intervals between 0 and 5 degrees, ten-degree intervals between 10 and 60 degrees, and one degree intervals between 65 and 75 degrees.

Input Data:

Radius of roll and the a and b coordinates

of the point being studied.

Output Data:

Angle being computed, roll, and the X and Y coordinates of the point at this angle of

roll.

STATE OF ILLINOIS

DIVISION OF HIGHWAYS

Program Abstract
Users' Project (Unassigned)

TITLE: Embankment Stability Design

TYPE: General

CATEGORY: Unrestricted

EQUIPMENT AFFECTED: G-15A G-15D MODE OF OPERATION: Intercom 101

PROBLEM STATEMENT: To determine the steepest slope that will

provide a Factor of Safety in excess of a predetermined minimum, and to determine an alternate berm design if the required slope

is greater than 3:1.

POSSIBLE VARIATIONS IN DESIGN: Slopes analyzed are 2:1, 3:1, 4:1, 6:1, 8:1, and 10:1. The berm is of

4:1, 6:1, 8:1, and 10:1. The berm is of standard design, consisting of a 2:1 slope from the shoulder to mid-height of the embankment, a horizontal berm extending from this point outward the desired distance, and a 2:1 slope from the out edge of the berm to the toe of embankment. The shortest satisfactory berm is determined in increments of feet.

THEORY AND MATHEMATICAL METHOD USED: The method of analysis used
is based on the procedure set forth by Terzughi
and Peck in their book "Soil Mechanics in Engineering
Practice". Factor of Safety = Ratio of Resisting
Weight Moments and Shearing Moments along Cir-

cular Arc to Driving Weight Moments.

LIMITING SOIL CONDITIONS: Three horizontal layers of cohesive soils below the embankment may be analyzed. The embankment must be homogeneous but may consist of any type soil.

Program by Miles E. Byers June 1, 1958

INFLUENCE LINES FOR 3-SPAN FRAME STRUCTURE WITH 2 INTEGRAL LEGS

Definition of Problem

This program will determine the moments in the longitudinal members to the left and right of supports and at the top of the integral legs for a three span frame with integral legs at the centre supports. The external supports may be restrained or free to expand and are not integral with the abutments.

The program determines the moments for each of 30 load positions, (ten in each span) located at the centre of the tenth points of each span.

It is anticipated that this program will be extended to calculate reactions and mid-span moments at a later date.

INFLUENCE LINES FOR 4-SPAN FRAME STRUCTURE WITH 3 INTEGRAL LEGS

Definition of Problem

This program will determine the moments in the longitudinal members to the left and right of supports and at the top of the integral legs for a four span frame with integral legs at the centre supports. The external supports may be restrained or free to expand and are not integral with the abutments.

The program determines the moments for each of 40 load positions, (ten in each span) located at the centre of the tenth points of each span.

It is anticipated that this program will be extended to calculate reactions and mid-span moments at a later date.

STATISTICAL ANALYSIS FOR QUALITY CONTROL

Program Abstract

This program makes statistical analyses of test data for quality control to provide information as to frequency of occurrence for density and moisture control tests used for construction control and evaluation purposes. Frequency of occurrence is established for 4 conditions:

- 1. Field unit dry weight at 1-pound intervals.
- 2. Relative dry density (percent compaction) at 1 percent intervals.
- 3. Field moisture content at 1 percent intervals.
- 4. Field moisture content variation from laboratory optimum at 0.5 percent intervals.

For each of these 4 conditions the following values are calculated:

- 1. Percentiles.
- 2. Arithmetic mean (\overline{X}) .
- 3. Standard deviation (0).
- 4. Skewness (K).
- 5. Lower Quartile.
- 6. Median.
- 7. Upper Quartile.

SIMULTANEOUS EQUATION SOLUTION SUBROUTINE

Portland Cement Association

March 13, 1958

Synopsis

A simultaneous equation solution is presented which is relocatable, expandable, and as versatile as possible. The solution is based on a simple equation elimination procedure which is basically a matrix inversion. The subroutine is divided into two distinct parts. Part I is called the Left Hand Side Reduction. This part performs a matrix inversion on the coefficients of the unknowns. Part II is the Right Hand Side Reduction and Answers Calculation. This part solves the equations for one set of constants which appear in the equations. Each part is entered separately by a Marked Place Transfer. In this way, any number of Right Hand Side Constants may be supplied and the reduction of the Left Hand Side Coefficients does not need to be repeated. This feature will allow much faster computation for equations which change only in the constants.

The subroutine presented is written in Intercom 101D language for eight simultaneous equations. However, it could be easily rewritten in any computer language which has available at least five index registers. It has been made relocatable by noting all of the instructions which involve a specific address. The number of equations to be solved is supplied in several places in the subroutine. This number can be changed to accommodate any number of equations desired. Of course the limitation on number of equations is the data storage space available. The subroutines will solve a number of equations less than that for which it is written if the coefficients are supplied in the upper left hand corner of the Left Hand Side Coefficients. The data layout is illustrated in the program description.

Computation speed in a seven equation example problem was 120 seconds for the Left Hand Side Reduction and 30 seconds for the Right Hand Side Reduction and Answers Calculation for each set of constant coefficients. The complete subroutine occupies 113 spaces.

ALFRED BENESCH & ASSOCIATES 10 South Wabash Avenue Chicago 3, Illinois

Reinforcing Steel Quantities Program
Type: Class 2 Mode: Machine Language

Abstract

This program calculates the weight of individual groups of reinforcing bars, sorts them according to various options, and provides the total weight of reinforcing steel. In addition, subtotals and cumulative totals may be obtained when desired.

A type back routine is included to insure that the data has been entered into the computer correctly. Repetition of any incorrect data, preceded by a minus sign, adjusts the various totals to compensate for the error.

The program handles up to 5,000 tons of steel per grand total. There are no practical limitations on the bundle data as the program can handle up to 1,000 bars up to 100 feet in length per bundle. All standard sizes, #2 through #11, and the special sizes #14 (2.25 sq.in.) and #18 (4.00 sq.in.) can be accommodated.

Input is in a two word unit; the first contains the quantity and size of bars in the bundle; the second the length in feet and inches. Output occurs on the same line and includes a typeback of the quantity, size, and length (feet and decimal fraction) as well as the bundle weight. Typing of the appropriate flag causes a subtotal, cumulative total (sum of previously typed subtotals), or the grand total (sum of previously typed cumulative totals) to be typed. Input resulting in exceeding the 5,000 ton grand total limit is rejected. The program is reset for another production run automatically after a grand total typeout.

Four options are available at present by combining and/or rejecting alternates. Alternate 1 permits either one or two-division separation (e.g., straight or bent bars). Alternate 2 permits either grand total accumulations only or a 3-stage accumulation. Alternate 3, provided for but not completely programmed, will permit storing by sizes; coding of this alternate will make eight options available. The program is coded for direct typewriter input; however, it can be converted for use with off-line data tape preparation equipment with a corresponding reduction in computer time to 6 seconds per bundle.

Computing time is less than 2 seconds per bundle; however, one complete input-output cycle requires at least 14 seconds.

Users' Project No. 132

MULTIPLE REGRESSION ANALYSIS

The scope is: multiple regression analysis for n sets of observations on k functions of independent variables and one dependent variable, Y.

Limits: k must be equal to or less than 19.

n is unlimited except that no sum or product in the computations may be greater than 2^{120} .

Includes generation of sums of squares and products, abbreviated Doolittle solution of up to 19 least squares normal equations, computation of means and standard deviations of the variables, sums of squares for error and regression, root mean square of regression residuals, squared multiple correlation coefficient, Y (multiple regression estimates of Y) and individual residuals. Provides for automatically dropping last variable, last two variables,... and recomputing. All computations are in double precision - approximately 10 significant figures.

PROGRAM ABSTRACT

Users' Project Number 133

Program: Stringer Layout Geometry (G-2)

Class: 2

Originator: Parsons, Brinckerhoff, Hall & Macdonald, Inc.

June 6, 1958

This program computes the lengths of all stringers in a bridge span, center to center of bearings; the skew angle that each stringer makes with each pier; and the station and offset of each stringer bearing point.

Given must be the bearings of all piers and abutments; any curvature of the base line (radius, P.C. station, P.T. station); and the station of each pier or abutment.

The program will process up to 24 stringers in a span. The span may be on full tangent alignment, full circular curve alignment, or may straddle a P.C. or P.T. The stringers or piers need not be parallel.

The program is written in Intercom 1000 (T.A.M. #24A) and completely fills the interpretive memory. The computing time varies with the alignment case; however, for a typical circular alignment, seven minutes of computation is required for the first stringer and three minutes per stringer thereafter.

STATE OF ILLINOIS DIVISION OF HIGHWAYS BUREAU OF RESEARCH AND PLANNING

Program Abstract
Users' Project (Unassigned)

TITLE: Bridge Deck Elevations

CATEGORY: Unrestricted

EQUIPMENT AND MODE OF OPERATION: G-15D Intercom 1000

PROBLEM STATEMENT: To compute the elevations, on the wearing surface (or bottom of bridge floor) for bridges either on a horizontal tangent or curve, along lines parallel to the centerline of piers and face of abutments at any desired intervals and over the centerline of all beams.

INPUT DATA: In general, the number and specing of beams, the number and spacings of lines parallel to piers along which elevations are to be computed, the skew angle, the gradients and the limits of the vertical curve and a reference station with its elevation for use in computing elevations, the amount and definition of roadway crown, the amount of superelevation and the centerline radius if a horizontal curve is involved.

OUIPUT: Three columns. Column one shows the station number, column two the offset from centerline and column three the elevation.

LIMITATIONS:

Number of beams = 15.

Lines along which elevations are to be computed must be parallel but can be skewed at any angle.

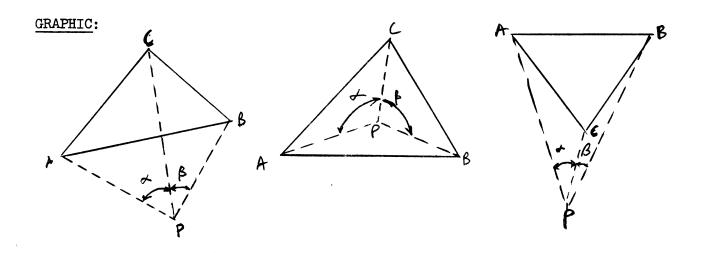
Number of variations in line spacings = 15.

Number of lines of equal spacings = no practical limit.

Beams must be parallel.

THREE-POINT PROBLEM SOLUTION BY RUNGE'S METHOD

After a triangulation system is completed, it frequently is desirable to locate additional instrument stations in connection with subsequent work. The solution of a fourth point from three points of known coordinates is known generally in surveying as the Three-Point Problem.



P = Point to be located X & Y coordinates

A,B, & C = Points on known X & Y coordinates

= Measured angles

NOTE: Viewed from Point "P", points "A", "C" & "B" are located respectively clockwise. Angle is measured between points "A" and "C", and angle is measured between points "B" and "C".

SOLUTION:

The classic solution of this problem is quite involved mathematically and also minus signs in coordinates become difficult to handle, however, by Runge's formulas it is very direct:

Users' Project No. 136

ABSTRACT BL-23 (INTERCOM 103D) LATENT ROOTS AND CHARACTERISTIC VECTORS OF A MATRIX.

This program was written to extract the latent roots and characteristic vectors of non-negative definite matrices such as correlation matrices. It will also work on some other classes of matrices. Up to twelve roots and vectors may be extracted from matrices up through order 15 x 15. The method used is an iterative method based on postmultiplication of the matrix by an arbitrary column. The iteration will converge to a solution if the roots are real and distinct and if the initial arbitrary column is not orthogonal to the vector. The roots and their associated vectors are obtained one at a time in order of decreasing magnitude of the roots. The rate of convergence is governed by the ratio of the root being extracted to the next largest root. If this ratio is near one, the rate of convergence will be low.

PALMER & BAKER ENGINEERS, INC.

DESIGN COMPUTATIONS

SHEET NO.____

MADE BY Chappell DATE 7-17-59

PROGRAM FOR BENDIX G-15D COMPUTER SUBJECT MATTER.

CHECKED BY F.G.CDATE 7-17-59

Abstract of Users Project No. 137

Class

Supplement No. 1

Title:

HIGHWAY PROFILES

Mode:

Intercom 1000

Address:

Originator: Palmer & Baker Engineers, Inc. P.O.Box 346, Mobile, Alabama

Date:

July 17, 1959

This is a modification of Users Project 137, and describes the changes to be made to that program only. In order to adapt these changes, it will be necessary to first obtain the original program.

The changes provide for a simplified input procedure, a columner output format, and the output of elevations less than +8.00, both positive and negative elevations.

The New York State criteria for vertical curve design has been eliminated.

Subroutines used: see Users Project 137

Auxiliary equipment used: none

Computation time: varies

PROGRAM ABSTRACT

Program: Highway Profiles (G-1)

Cless: 2

Originator: Parsons, Brinckerhoff, Hall & Macdonald

June 13, 1958

This program computes elevations along a highway profile.

Elevations are found for the theoretical profile line and, if desired, for one, dependent, offset line, at stations at any constant interval and at any "odd-plus" station desired. In addition, elevations at the limits and midpoint of vertical curves are produced, as well as at the high point or low point if one exists.

The relative location of the offset line is defined by an offset distance and a cross-slope, either of which may vary linearly, simultaneously or individually.

Also, if desired, the program will design the vertical curves, by either the AASHO or the New York State stopping sight-distance criteria.

This program is written in Intercom 1000 (T.A.M. 24A) and completely fills the interpretive memory.

FIT ANALYSIS BY LEAST SQUARES (FABLES)

In the course of engineering work, as well as other scientific endeavor, it is often necessary to derive from observed or experimental data equations that readily describe the relationship between independent and dependent variables. The derivation of such equations frequently requires a knowledge of the exact mathematical functions that describe the physical relationships involved, if such exists, or some approximation which will adequately describe the relationships for purposes of interpolation, extrapolation, etc. It was the objective of this program to provide a means for rapidly determining such equations or approximations through data analysis on an electronic computer.

A program has been written for the Bendix G-15D Computer that permits a determination of the coefficients for an equation that best describes the relationship between two variables. In so doing, the program fits data by the method of least squares to functions of the following form, and computes the standard deviation for each of the following functions as a test of fit.

1. LINEAR FUNCTION
$$Y = A_0 + A_1 X$$

2. QUADRATIC FUNCTION
$$Y = A_0 + A_1 X + A_2 X^2$$

3. EXPONENTIAL FUNCTION
$$Y = A_O e^{A_1 X}$$

5. POWER FUNCTION
$$Y = A_0 X^{A_1}$$

This program provides a means for rapidly correlating experimental or operational data for use in engineering design or economic studies.

Specifically, a Bendix G-15D Computer program was written which determines by the method of least squares the coefficients of an equation that best describes a set of data. The residuals between the observed and calculated set of values are minimized by this statistical technique, thereby providing for the particular function the best possible mathematical description of the data. Five types of functions are covered by this program; linear, quadratic, exponential, logarithmic, and power.

To provide a means for determining which of the above mathematical functions is the best representation of the physical relationships involved, the program also computes the standard derivation of the calculated values from the observed values. Moreover, it is possible with this program to automatically fit data to any one of the above functions separately or to the entire group for a comparison of the standard deviations as a test of fit between functions or between groups of data.

The derivation of the equations and the mathematical techniques used in this program are given in Part II. A formal proof of the method of least squares for two variables can be found in any statistical text and, therefore, is not included in this report. Likewise the solution of simultaneous equations by Cramer's rule of elimination using determinates is omitted, since it is covered in college algebra texts.

Users' Project No. 139

BEAM GRID ELEVATIONS

ABSTRACT

This program is written in Intercom 1000 for the Bendix G-15D Computer. The program will compute elevations, including dead load deflection, at the top of the slab and bottom of the beam, for up to 50 points on a longitudinal bridge beam. The program is limited to 11 beams. Bridge may be skowed or straight, on either a vertical curve or tangent (no horizontal curve).

Required input includes skew and vertical curve data, crown corrections, beam spacing, distance between longitudinal points on a beam, and D. L. deflection. If bottom of beam elevations are required, input must also include depth of beam at each point, each beam having the same depths at corresponding points.

Top of slab elevations, including dead load deflection, are typed for every problem. In addition, the designer may select other output formats to include top of slab elevations without dead load deflection, or bottom of beam elevations with deflection included, or both.

PALMER AND BAKER ENGINEERS. INC.

MOBILE, ALABAMA

Users' Project No. 140

ABSTRACT

THREE-COLUMN RIGID-FRAME PIER ANALYSIS

The program is coded for the Bendix G^2 -150 in Intercom 1000 (Tech. Appl. Hemo. No. 24A and 30). No Subroutines are used.

The structure analyzed has three fixed-base columns, equally spaced and of equal height and of constant cross section. The cap beam is of constant section and may cantilever over the outside calumns.

The structure is analyzed for a uniform vertical load on the cap beam, zero to two concentrated vertical loads on each cantilever, zero to four concentrated vertical loads on each span and a transverse horizontal load at the centerline of the cap beam.

The program will compute bending moments and shears at all joints of the frame and additional bending moments in the cap beam at all points of concentrated load. The program requires tenminutes of machine time including type-in and type-out.

CATEGORY CLASS 11

Users' Project No. 141

ABUTMENT DESIGN Class 2

ALSTRACT

Given abutment dimensions, live and dead load reactions from superstructure and other data, the program computes footing pressure or pile loads and area of steel required at toe and heel for the four cases of loading (Use Michigan State Highway Department Specifications).

- 1. Substructure D. L. +2. Weight of Earth +3. Horizontal Earth Pressure.
- 1. Substructure D. L. +2. Weight of Earth +3.
 Horizontal Earth Pressure +4 Superstructure
 D. L. +5 Live Load on Approaches.
- 1. Substructure .L. +2. Weight of Earth +3.
 Horizontal Earth Pressure +4 Superstructure
 D. L. +6 Superstructure L. L.
- 1. Substructure D. L. +2 Weight of Earth +4 Superstructure D. L.

HERCULES POWDER COMPANY

USERS' PROJECT NO. 142

DAISY 201 Appendix No. 033 Edited Fixed Point Output

Abstract

It is frequently desirable to edit the results of a computation and to type these results out in the final form in which they will be used — for example, tables for a publication or for routine use in an office, plant, or laboratory. If the computation has been carried out with a floating-point interpretive system such as DAISY 201, the output will often be most acceptable if it is converted to fixed-point notation. In addition, it is desirable to type columns of numbers with the decimal points in a vertical line, even if the numbers so listed may cover several orders of magnitude in value. This routine provides an edited, fixed-point output for the DAISY 201 system, giving the programmer a wide choice of output formats.

Given a decimal number in excess-50 floating-point form, make up a format with a designated number of integral and fractional digit positions, and shift the output number to position the decimal point for fixed-point output.

MULTIPLE REGRESSION ANALYSIS ELECTRONIC COMPUTER PROGRAM

for

BENDIX G-15 D INTERCOM 101 D

Class I

Portland Cement Association 33 West Grand Avenue Chicago 10, Illinois

1958

Abstract

Multiple regression analysis uses least square methods to determine the unknown constants in an equation relating a dependent variable to several independent variables. Application of this method is made when there are several different types of tests or observations on each of a number of samples and it is desired to examine the degree to which the variables are related. It may be desired to predict or estimate the value of a particular factor from other test factors on the same sample.

After the data or test factor values are typed in, the computer solves for the unknown constants (regression coefficients) that are used to make the estimates. The probable accuracy of the estimate (standard error) is also typed out.

The program is a solution for linear regression problems involving from 1 to 8 independent variables with up to 60 sets of observations. An unlimited number of observations can be accommodated with slight modification of the program. Non-linear regression problems may also be solved.

United States Army, Corps of Engineers

Los Angeles, California

Users' Project No. 144

CONVERSION OF COORDINATES TO DISTANCE AND BEARING

This program calculates the length and bearing of a line segment between known Lambert position coordinates

Data can be stored for a maximum of 223 line segments.

United States Army, Corps of Engineers

Los Angeles, California

Users' Project No. 145

TRAVERSE INTERSECTION

The program calculates the lengths of 2 intersecting lines and the coordinates of their point of intersection when the bearings and the coordinates of a point on each line are given.

Data can be stored for a maximum of 35 problems.

SHELL DEVELOPMENT CO. Emoryville, California

Users' Project No. 146

Class 1

ABSTRACT

This program operates under control of Intercom 1000. It provides a conventional analysis-of-variance table and lists in standard measure the deviations of row means from the grand mean when the data pattern is of m rows by n columns with single entries at each row by column intersection. The limits are 241450, 2414100, provided that not over 22 entries are missing. The data are loaded one column at a time; results may be listed after each column is loaded if so desired. The progrem is interruptible for a memory dump at the beginning of any column of the data load. If any entries are missing, flags are loaded in their places; the program switches to a summation procedure that calculates the vector column for a matrix equation for calculating substitutions and punches a reloading tope, final results are then obtained by loading this transfer tape and the substitutions. After the final results are listed the data storage is erased and the program reset for a new data load.

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Relagued 1 November 1958

design of channel u-wall.

STATEMENT OF PROBLEM

5. Input Data.

Cell Location	Symbol	Unit	Definition (Refer to Fig. 1, 2, and 3)
Q00	1.	foot	Half of width of channel.
001	H	foot	Height of channel (invert to top wall).
002	*	inch	Width of top of wall.
003	#	inch	Width of slab at & of channel.
004	tw	inch	Width of wall at slab.
005	ts	inch	Thickness of slab at heel.
00 6	ø	degree	Angle of internal friction.
007	k _w	inch	Cover to & of reinforcing steel in stem.
800	k _s	inch	Cover to & of reinforcing steel in slab.
009	$\mathbf{k}_{\mathbf{z}}$	inch	Wearing surface.
010	Ha	foot	Length of heel.
011	Kw	p.s.f.	Coeff. of horiz. component of earth pressure. (NOTH: If no surcharge, store -1 here)
015	Kc	p.s.f.	Coefficient of active earth pressure.
01.3	*	p.c.f.	Unit weight of soil.
014	*c	p.6.f.	Unit weight of concrete.
015	fs	p.s.1.	Maximum allowable tension in steel.
016	e	none i.	Constant for computation of j. *
017	12	p.s.i.	Maximum allowable bond.
018	¥	p.s.1.	Maximum allowable diagonal shear.
019	22.	none	Ratio of modulus of elasticity of steel to come.
020	flag cell		
021 033 036	kt K	p.c.f. inch p.s.i[j()	Weight of water. Conc. cover to c.g. of top reinf. steel in slab. Compression factor. Min. alloyable)-1
- 4	a = y va.		K(liax. allowable)

SLAB FILLET DETERMINATION

USERS' PROJECT NO. 148

DEFINITION:

This program will calculate the slab fillet thicknesses, the beam elevation at bearing points and the elevations required for steel fabrication (blocking dimensions) for a continuous steel bridge beam of four spans with splice points in the second, third and fourth spans.

The program will calculate the dead load deflections, the undeflected beam elevations, the final pavement elevations and combine this information to give the desired output.

PROGRAM SPECIFICATIONS

MODE	INTERCOM LO3
INSTRUCTIONS	433
INDEX REGISTERS USED	4
COMPUTING TIME	10 to 20 MINS.

Abstract of Users Project No. 149

Title:

WATER AND SEWER RATE REVENUE COMPUTATION

Cless:

2

Mode:

101D and 1000s

Criginator:

J. S. WATKING CONSULTING ENGINEERS

Dato:

August 10, 1958

This program was written to compute the repetitive extension of water and sower rate schedules. Given the number of customers and the average smounts of water used from a bill analysis, the program will compute the average bill and the total bill for each bracket for both water and sower rates. These totals are accumulated for the revenue of a given span of time, this is then converted to annual revenue for both water and sower, added together to obtain a total annual revenue.

This program is limited to 100 brackets of water customers, 100 sever customers and their amounts of water used. The program will handle 20 water consumption brackets, 7 sewer consumption brackets.

The input will include the following:

Number water customers, Amount of water used, Number sewer customers, Water rates per unit, Water limits, Sewer rates (per cent of water), Sewer Limits, Minimum water bill and minimum sewer bill.

The cutput will include the following:

Water Customers

Avg. Water Bill

Total Bill

Sewer Customers Avg. Sever Bill

Total Bill

Total for span of time

Total for upan of time

Annual Water Revenue Annual Sever Revenue Total Janual Mevenue

About 15 seconds per line of typeout is required for computation.

No auxiliary equipment needed. Flexowriter can be used with minor elteration to program.

-141-

CITY OF CHICAGO

Users' Project No. 150

ABSTRACT

PROGRAM FOR URBAN RUNOFF COMPUTATIONS

This problem is programmed in Intercom 101 and divided into three parts which are designated as follows:

- P-1A or P-1B This part of the program will determine a

 Design Storm Pattern, when the formula for the rateduration frequency curve is known and the maximum
 duration and the advanceness ratio of storm are given.

 It will also determine the infiltration offset which
 will be used in subsequent parts of the problem.
- P-2 - By using the design storm pattern and the infiltration offset developed in P-lA or P-lB, and by entering the appropriate constants for infiltration, depression storage, overland flow, and gutter flow, this part of the program will determine the hydrographs of flow into one or two gutter inlets.
- P-3 - - The gutter hydrographs developed in P-2 are collected and routed through the sewers to form the hydrograph along the laterals and main sewers.

 The peak flows of these hydrographs are then used as the design discharge in the selection of sewer sizes.

USERS' PROJECT NO. 151

Bendix Computer Program No. E-1

Decimal Algebraic Addition

HERCULES POWDER COMPANY

Abstract

This program adds two signed 14-decimal digit numbers directly, without conversion to binary. The numbers to be added must be in line 21; the sum appears in PN, with the sign in the special sign register. Execution time is somewhat less than one drum cycle, and the addition can be carried on during input or output, since neither line 19 nor line 23 is used.

E I DUPONT DENEMOURS AND COMPANY

Users' Project No. 152

ABSTRACT

Daisy 201 Appendix No. 035 permits programming the punching of paper tape by the Daisy order

n-Ou 000 k

where \underline{n} is the Appendix line and \underline{k} is any index register the B portion of which has been set to the first location and the L portion to the last location to be punched.

Mechanigal Division



PACT_OF_ DATE 1/23/7 LINE GA

G-150 PROGRAM MAGNETIC TAPE SEARCH ROUTINE

PREPARED BY He de Chilat

ABSTRACT

USERS' PROJECT NO. 153

The function of the MTSR routine is to search for and locate specific files of data (in proper form-see routine description) stored on magnetit tape.

The basic package is stored and operated from line page line 19 is used for working storage and for input from the a guello tape. The arithmetic registers and all four word lines are used by this routine.

The routine will locate the leading block of the specified file on the magnetic tape and transfer the content of this block to Line 19 of the computer.

American Viscose Corporation

Users' Project No. 154

Abstract

Type:

Subroutine

Equipment

G-15D

Mode of Operation:

Single precision fixed point input Double precision floating point output

Execution:

Line 05

Entry:

37

Exita

Return command in 23.03

Scaling:

Integer input converted to Double

Precision Floating Point

Data Output:

Places converted number in A register

(Daisy order address meaningless)

Data Input:

Type in decimal integer (single precision)

Execution Time:

Six Rev.

Error Stops:

None

Words Not Used are shown as blank on Memory Allocation Chart, except word

58 which is a constant 0000000.

Storage Lines:

Lines 05, 20, 21, 22, 23

Summation Constants:

02 = 5209385u6 = -17425W

Remarks:

Ring bell to announce "Permit type in"

Type in does not require leading zeroes

and is terminated "tab S".

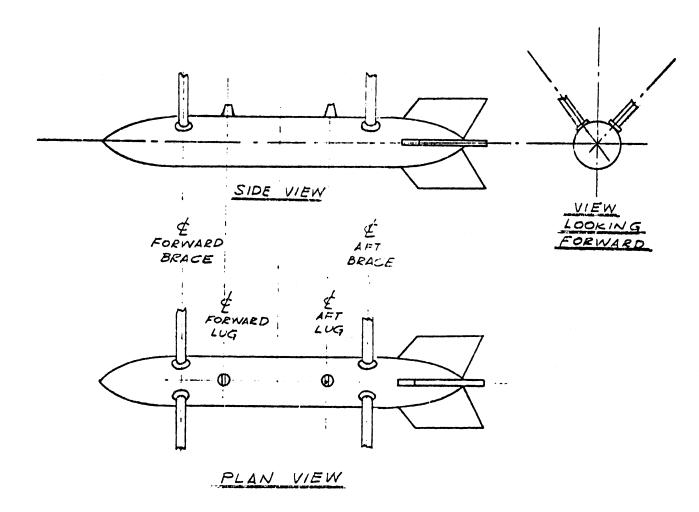
U S NAVAL AIR DEVELOPMENT CENTER

User's Project No. 155

SUSPENSION REACTIONS FOR AIRBORNE STORES

This program computes the lug and sway brace reactions on an airborne store, suspended by a tandem lug and sway brace configuration of the type shown below, in accordance with the Appendix to Military Specification MIL-A-8591 (ASG).

Required input information is the suspension geometry and the total loads at the store center of gravity. As written, this program will compute all of the suspension reactions for as many as twenty loading cases.



Abstract of Users' Project No. 156

Title: VERTICAL ALIGNMENT PROGRAM

Class: 2

Mode: Intercom 1000 (T.A.M. 24A)

Originator: J. E. Greiner Company

Consulting Engineers
Baltimore, Maryland

Date: August 1958

This program computes rates of grade, the station and profile grade of each P.V.C. and P.V.T., the profile grade at each station equality, and profile grade as specified along the grade line. Profile grades may be computed at specified increments, or at several different specified increments, and at special (odd "plus") stations. Profile grades may be obtained in one desired segment, called "incremented segments" in this program, or in several segments which need not be adjacent.

The program handles a maximum of seventeen (17) P.V.I.'s and/or seventeen (17) incremented segments, and four (4) station equalities.

Input Data: P.V.I. stations and elevations, vertical curve lengths, station equalities, segment limits and increment for which profile grade is desired, special or odd "plus" stations for which profile grade is desired.

Output Data: Table giving P.V.I. station, P.V.I. elevation, grade from, P.V.C. station and P.V.T. station. Sequential listing of stations and corresponding profile grades for initial and final stations, P.V.C.'s and P.V.T.'s, back and ahead stations of equalities, and special (odd "plus") stations.

Upon completion of table typeout, profile grade is typed out at the rate of approximately four stations per minute.

JOHN F. MEISSNER ENGINEERS, INC.

Users' Project No. 157

An de Conversion Subroutines

Prog. #1.30

Subroutine Abstract

The subroutines convert radians or decimal degrees to one word andles or bearings in degrees, minutes and decimal seconds; and one word degrees, minutes and decimal seconds to radians and decimal degrees. The conversions are performed by shifting and rounding the DAISY accumulator.

BY O. Landryo ATE	CLIENT	SHEET NO.
	SUBJECT	JOB NO.
REF	Program Abstract	REF Prog. #1.19.1
	JOHN METSHNEE ENGTHETES	

Users' Project No. 158 FORESECTION FROM COORDINATE DATA

Problem

Given the coordinates of two points on a base line of known location, and the coordinates of other points to be relatively located the program computes the required information.

Input Data

The input data required is:

 X_1 , Y_1 and X_2 , Y_2 - The coordinates of the two known points on the base line.

The coordinates of the point to be located relative to the base line.

N - The number of points to be located from one base line.

The number of base lines used in one computation session is also required.

The program will accept a maximum of ten (10) base lines in one session, and a maximum of fifteen (15) points to be located from each base line entry.

Output

For each base line the input coordinates are types in one row (X_1, Y_1, X_2, Y_2) . The next row is the distance and north azimuth from base line points P_1 to P_2 .

For each point to be located the first row is the input coordinates (X_x, Y_x) . The second row is the distance from P_1 to P_x , and angle 2-1-X. The third row is the distance from P_2 to P_x , and the angle 1-2-X.

All angles are in degrees, minutes and seconds compacted into one word.

Computation Mathod

The azimuths and lengths of all lines are computed from the coordinate data, and interior angles are computed from differences in azimuth.

The conversion from decimal degrees to degrees minutes and seconds is accomplished by shifting and rounding the floating-point accumulator.

Users' Project No. 159

PROGRAM ABSTRACT

Program: Alignment Subroutines (G-4)

Class: 1

Mode: INTERCOM 1000 (T.A.M. #24A)

Originator: Parsons, Brinckerhoff, Hall & Macdonald

September 5, 1958

This program solves three independent horizontal geometry problems: triangle solution, curve data, and line solution.

Priangle Solution

This subroutine completely solves any triangle, producing the lengths of all three sides and the values of all three interior angles. Given must be any minimum combination of side lengths and/or interior angles.

Curve Data

This subroutine produces the following eight circular curve elements: the radius, central or deflection angle, degree of curvature, arc length, tangent distance, external distance, middle ordinate, and chord length. Given may be any twelve different pairs of known curve elements.

Line Solution

This subroutine completely solves a one-sided traverse (a) producing the end point coordinates of a line defined by its length, bearing, and initial point coordinates; or (b) producing the length, azimuth, and bearing of a line defined by the coordinates of the end points.

COMPUTING DEVICES OF CANADA

Users' Project No. 160

ABSTRACT

Given a sequence of real numbers

$$x_1, y_1, x_2, y_2, \ldots,$$

the program computes and types out the following quantities:

k,
$$r_k$$
, $\sum x_j$, $\sum Y_{j+k}$, $\sum x_j^2$, $\sum x_j Y_{j+k}$, $\sum Y_{j+k}^2$
for $k = \beta$, $\beta + \alpha$, $\beta + 2\alpha$,...., $\beta + p\alpha$, where $\beta + p\alpha \le m$, $\beta + (p+1)\alpha > m$, where $r_k = N \sum x_j Y_{j+k} - \sum x_j \sum Y_{j+k}$

$$\sqrt{(N \sum x_j^2 - \sum^2 x_j) (N \sum x_{j+k}^2 - \sum^2 x_{j+k})}$$

and the summation \sum is for j=1,2,...., N. The numbers X_j and Y_j are stored as single-precision hexadecimal numbers on magnetic tape. Arithmetic is performed in fixed-point and double-precision throughout and output is double-precision.

Users' Project No. 161

Abstract

Once given a right handed coordinate system in 3 dimensions, a new coordinate system may be found by first translating along each of the axes then rotating it about each of the coordinate axes.

This can be found by the application of the followins:

$$\begin{pmatrix} x' \\ y' \\ y' \\ = \begin{pmatrix} (x-x_0) \cos \alpha \cos \beta + (y-y_0) \sin \alpha \sin \beta - (z-z_0) \sin \beta \\ (x-x_0) (\cos \alpha \sin \beta \sin \gamma - \sin \alpha \cos \gamma) + (y-y_0) (\cos \alpha \cos \gamma + \sin \alpha \sin \beta \sin \gamma) + (z-z_0) (\cos \beta \sin \gamma) \\ (x-x_0) (\sin \alpha \sin \gamma + \cos \alpha \sin \beta \cos \gamma) + (y-y_0) (\sin \alpha \sin \beta \cos \gamma - \cos \alpha \sin \gamma) + (z-z_0) \cos \beta \cos \gamma \end{pmatrix}$$

U S NAVAL AIR DEVELOPMENT CENTER

Users' Project No. 162
CONVERSION AND SCALING ROUTINE

ABSTRACT

This program converts decimal integers to scaled binary fractions. This is accomplished by converting the decimal integer to a binary integer, scaling this binary integer by a prescribed power of 2 to make the result less than unity, and typing the result in hexadecimal form (i.e., the hexadecimal equivalent of N x 2^{-T}).

Provision has been included for the entry of values of N and r from the typewriter. Values of N may also be entered from punched tape which has been prepared on an off-line Flaxowriter.

This service routine is of particular value during program preparation.

Abstract of Users Project No. 163

Title:

FOUR SPAN RIGID FRAME BRIDGE

Class:
Mode:
Originator:
Date:

2
Intercom 1000
Tudor Engineering Company
August, 1958

Given the dimensions and moments of inertia of the various elements of a rigid frame of not more than 4 spans, the program will compute moments, shears and reactions for several conditions of loading.

The rigid frame may have variable spans and column heights with cantilevers at either end. The members of the frame must be prismatic; however, the legs of the frame may consist of solid diaphragms or rows of columns.

The loading conditions handled by this program are as follows: (1) Unit uniform load in each span, (2) Unit concentrated load at the 1/10th, 3/10th, 5/10th, 7/10th and 9/10th point in each span, (3)Unit moments at the top of the end piers, (4) Unit horizontal force at the top of the pier, (5) cantilever unit moments, (6) Temperature and shrinkage corrected for sidesway, (7) Several cases of uniform dead load corrected for sidesway, (8) Earthpressure against abutments corrected for sidesway, (9) Earthquake acting on the dead load of the rigid frame corrected for sidesway.

The program is prepared in two parts with loadings (1) through (6) computed in the first part and (7) through (9) computed in the latter. The input for part one consist of span lengths, column heights, and the moment of inertia for each member. The pier fixity is indicated by a sign preceding its moment of inertia. The input for the second part consists of the frame dimensions, the weight of the various elements, intensities of dead load and soil pressure, a surcharge, and an earthquake factor.

The output gives the moments at each joint, moment at the centerline of each span, shear at the face of the piers, vertical reaction at the top of the piers, and horizontal reaction at the base of the pier for each case of loading. The output format identifies the loading and the pier number.

Moment distribution is used to calculate the frame moments. The number of cycles can be varied. Horizontal earthquake forces are based on a percentage of the deadload and can be adjusted to suit various localities. The program is intended for use with frames with piers hinged at the base. For piers hinged at the top, the program will analyze the spans as a continuous beam. In a frame with one or more piers fixed at the top and bottom, the computed results will be correct for loadings (1), (2), (3), and (5) only.

The time required to put in the data for part one and two requires about ten minutes for each part. The running time for a complete analysis of a four span rigid frame is about 3 hours. Somewhat less time is required for frames with less than four spans. No auxiliary equipment is required.

Abstract of User's Project No. 164

TITLE:

DEFLECTION ANGLES FOR HORIZONTAL CURVES

CLASS:

2

MODE: ORIGINATOR:

INTERCOM 1000 - DOUBLE PRECISION

EDWARDS AND KELCEY, ENGINEERS

DATE:

SEPTEMBER, 1958

This program computes the deflection angles and chord and arc distances required for staking-out a horizontal circular curve in the field.

The input consists of:

- 1. The P.C. (T.C.) and P.T. (C.T.) stations.
- 2. The distance from P.C. to first deflection point.
- 3. The regular distance between deflection points.
- 4. The deflection angle between the two tangents (equal to the contral angle).
- 5. The radius of the curve.
- 6. The length of the curve.

The output has the following format:

STATION TOTAL DEF. SUB-DEF. ARC DIST.

CHORD DIST. TOTAL ARC DIST.

The routine also computes and prints out at the end as a check the last total deflection minus one-half the deflection angle between tangents.

The designer may specify that 360 degrees minus the total deflection also be printed out at every station if the stake-out is to be done with a theodolite.

Distances are accurate to \pm 0.001 feet and angles are accurate to \pm 0.01 seconds. Arc definition of curve is followed and standard formulas are used in the computation.

Coding sheets are included with the write-up. Each curve requires about 3 minutes for data type-in. Computation time and type out varies with the length of curve etc., but runs from 3-10 minutes per curve. Up to 20 curves maximum can be processed during one run.

Title: Horizontal Curve Data

Class: 2

Mode: Intercom 1000 - Double Precision Originator: Edwards and Kelcey, Engineers

Date: September, 1958

This program computes various properties associated with simple horizontal circular curves.

The input consists of:

- 1. North and East coordinates of the point of intersection between the two tangents.
- 2. The magnetic bearing of the two tangents in degrees, minutes and seconds.
- 3. Code numbers which indicate the direction of the bearings (i.e. NE, SE, SW, NW).
- 4. The deflection angle between teneents (which equals the control angle, I).
- 5. A choice is provided in the pre-rum for supplying either the degree of curve or tangent distance or radius.

The output has the following format:

Coordinates of the P.C. (T.C.)	Deflection Angle		
	Radius	Tangent	Boaring
Coordinates of the P.I.	Degree of Curve	•	•••
	Tangent Distance	Tangent I	Boaring
Coordinates of the P.T. (C.T.)	Length of Curve		•
	Extornal Distance		

Distances are accurate to + 1/1000 of a foot and angles are accurate to + 1/100 of a second. Standard formulas found in any surveying text are used and Tre definition of curve is followed. Coding Sheets are included in the write-up. Also included is a recoding in new intercom 1000 of the State of Illinois subroutine for angle conversion from degree minutes and seconds to fractional degrees and vice-versa.

Each curve requires about 3 minutes to type in data and 3 minutes for computation and type-out. Up to 20 curves may be processed at one time and no auxiliary equipment is required.



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

Bendix Computer G-15-D Program Library No.	Page
Name DAISY 201 Appendix No. 036 Accept Typed-In Number	Line

Users' Project No. 166
ABSTRACT

This routine, when used as an Appendix to Daisy 201, makes possible the programming of type-in of numbers. The converted number, on exit from the Appendix Routine, is in the A register and may be used as is or may be stored by a 5x order.

Users' Project No. 167

ABSTRACT

Class 1

This program in Intercom determines the coefficients of a multiple linear regression equation of the form

by the least squares method for up to 63 observations and for two to five variables. Certain measures of the degree of correlation achieved by the equation, namely the adjusted standard error of estimate, the adjusted coefficients of determination and correlation, and the adjusted coefficients of part determination are also computed and typed. Substitution of each set of observations into the regression equation to determine the resulting estimate of the dependent variable is also performed if desired.

A verification routine is included to facilitate checking date input.

Abstract of Users Project No. 168

Title:

INVESTIGATION OF REINFORCED CONCRETE DEAMS

Class:

2

node: Griginator: Intercom 1000 Single Precision Richardson, Gordon and Associates

Date: September 21, 1953

Given the detailed dimensions of the reinforced beam section and the moment and shear, this program will compute section properties, maximum concrete and steel bending stresses, bond and shearing stresses, and the resisting moment and shear capacities of the section.

This program is written to handle T, I, Dox and rectangular shapes with varible depth, flange width and depth, and web thickness. The program input data will accept up to three rows of tension steel and one row of compression steel. Also, the location of the centroidal axis which is the neutral axis may be either in the flange or the web.

Imput consists of the moment and shear at the section under investigation, flange width and depth, web thickness, distance of all rows of steel from compression face, bar size and number of bars in each row, allowable maximum concrete and steel bending stresses and allowable unit shearing and bond stresses.

The output format is shown in the write-up. The type out gives the maximum concrete and steel bending stresses and the shearing and bond stress values, the properties of the section, the resisting moment capacity of the section as governed by allowable concrete stress and steel stress, and the total shear capacity as governed by allowable bond stress and unit shearing stress.

The transformed section analysis was used as the basic approach to the investigation. For computing stresses the standard equations of reinforced concrete beam in bending in one direction were utilized as may be seen in the program write-up.

Data input requires approximately one minute. Computational and output time runs approximately one minute and thirty seconds.

BENDIX PRODUCTS DIVISION Transfer Function (Intercom 101) Class I

USERS' PROJECT NO. 169

ABSTRACT

Often a great amount of work is involved in finding the transfer function of a device. The differential equations which represent the action of the device are written and then variables eliminated one-by-one until only two remain, their ratio being the desired transfer function. This program was written to compute the transfer function from four equations (with five variables). Thus if only four differential equations suitably represent the device they may be entered directly into the pro-If more than four equations are written then variables must be eliminated by pencil and paper until there are left four equations in five variables. The transfer function from any variable to any other variable may then be computed with this program. One restriction is that the coefficient of no variable contain a higher order derivative than third. The gain and time constants are typed out as well as the coefficients of the two polynomials whose ratio is the transfer function.

Abstract of Users' Project # 170

Title: RELOADING ROUTINE FOR TRAVERSE CLOSURE PROGRAM - PROJECT #32

Class: 1

Mode: Machine Language G-15D

Originator: Cook County Highway Dept.

Date: September 2, 1958

This routine will reload the traverse program, Project 32, using the same codes for input options after a traverse problem has been completed without requiring rewinding the magazine and complete reading in of the program. It is to be attached to the end of the complete program tape. Once the program has been loaded or reloaded, a problem must be worked at least up to the point of the first typeout before it can be reloaded properly.

The routine repositions itself during reloading to be ready for another reloading operation.

Abstract of Users' Project #171 ...

Title: LINE VERSUS TAPE VERIFICATION ROUTINE

Class:

Mode: Machine Language G-15D

Originator: Cook County Highway Department

Date: August 25, 1958

This program requires a line in the G-15D, (any line from Line 1 to Line 18), to contain information that is to be checked against a block of tape that is on the photo-reader in position to be read. The operator types the line number to be tested, the block of tape is read, and each location is tested in order. Any location found to be different is indicated by a typcout of the word number in hex, the hex contents of the tape, and the hex contents of the location being tested. After all 107 locations have been tested, another line can be tested in the same way against the next block of tape.

The time required varies from less than a minute in the case that all locations are identical to several minutes in the case that there are many differences.

The use of the results from this program requires a knowledge of the sexadecimal system of numbers and machine language coding. It is useful for making modifications in programs originated by others to find changed locations, especially for writing reloading routines for self-destroying programs.

The program as written operates from Line O and is selfloading. It could be modified to operate from some other line, if desired, or to indicate those locations that are identical instead of different.

USERS! PROJECT NO. 172

Class 2

ABST RACT

MAISIE 850 (COMPLEX NUMBERS)

This program will solve up to 15 simultaneous linear equations in complex numbers, or will invert matrices in the same up to the 11th order. It is possible to invert a matrix end solve simultaneous equations at the same time, with possibly more than one set of dependent variables.

USERS' PROJECT NO. 173

Class 2

ABST RACT

ELSIE 820

(Evaluation of a Least Squares fit to Inconsistent Equations)

This program will take a series of not more than 36 linear simultaneous equations, and not more than 15 unknowns, and convert them into normalized equations, which may be entered into MAISIE 801, and the equations solved, or the matrix inverted. It operates in floating point double precision.

USERS' PROJECT NO. 174

Class 2

ABSTRACT

DAISY - MAISIE CONVERTERS

DAISY APPENDIX SUBROUTINES 010, 011, 012.

These subrottines enable a matrix or set of simultaneous equations to be prepared on DAISY 201 or 202, in a form acceptable to MAISE.

Subroutine #010 has been prepared for those who may not have MAISIE 801, which is the newform of MAISIE using shorter and more easily handled tapes. Tapes prepared by this subroutine are acceptable to the old form of MAISIE, which we will designated as MAISIE 800.

Subroutine #Oll prepares tapes in the shorter form acceptable to MAISIE 801.

Subrottine #012 prepares tapes for the complex form of MAISIE, designated as MAISIE 850.

USERS' PROJECT NO. 175

Class 2

ABSTRACT

DAISY - MAP 29 CONVERTER

DAISY APPENDIA SUBSCUTINE #013

This subroutine enables a matrix to be prepared on DAISY 201 or 202, in a form acceptable to MAP 29.

Mulien de l'Et de colorse. Z

USERS' PROJECT NO. 176

MIDWEST COMPUTER SERVICE, INC., DECATUR, ILL.

Electrical Network Load Flow Program

The method used is the nodal iterative method. It makes use of the usual nodal equations which equate the summation of currents entering (or leaving) a node to zero.

Because of limitations in the available storage the program is limited to a system of not more than 10 buses and/or 20 lines. Line charging is assumed to be lumped at the buses and is represented by a shunt admittance. Turns ratios may be taken into account by simple adjustment of the input data.

The input to the program consists of the following data:

1)
$$L_p = \frac{1}{q \cdot q \cdot pq}$$

2)
$$\frac{1}{L_p} = \sum_{q} Y_{pq}$$

4)
$$KL_p = (P_p - JQ_p) L_p$$

- 6) P_p -JQ $_p$ Loads are considered to be negative sources
- 7) 1.0
- 8) Constant for convergance test
- 9) Zeros in 397 and 398
- 10) Voltage magnitudes for fixed voltage buses
- 11) Acceleration factor

The following three equations are the heart of the program:

$$E_{p_1}^1 = \frac{KL_p}{E_{po}^*} \stackrel{\text{\tiny KL_p}}{\sim} A_p L_p \tag{1}$$

$$E_{p_1} = (E_{p_1}^1 - E_{po}) \varepsilon + E_{po}$$
 (2)

$$E_{p_2} = \frac{KL}{E_{p_1}^{\infty}} + \Lambda_{p}L_{p} \tag{3}$$

Where 6 = acceleration factor

After equations (1), (2), and (3) are solved new values of $A_{\rm p}$ are calculated and the above equations solved again.

The test for convergence is based on the difference between the calculated value of E_p for one iteration and the value calculated on the previous iteration.

Output:

Line Flows
Bus voltages
Bus loads and sources
Line losses

USERS' PROJECT NO. 177

CLASS 1 MULTIPLE REGRESSION PROGRAM

Abstract

The Multiple Regression Program is a machine language program for determining regression coefficients for experimental data. Arithmetic is carried out in floating-point double-precision. Data inputmay be from either the typewriter or from punched paper tape. There may be as many as four dependent variables and fifteen independent variables, including second order terms which may be generated by the program by multiplication of any selected pairs of variables. There is no limit to the number of experiments.

Accumulation of the X'X matrix and X'Y vectors is simultaneous with the type-in of data, so computation is ordinarily limited by the operator's typing speed. Accumulation of a 15 x 15 X'X matrix from paper tape requires about 45 seconds per experiment. The X'X matrix may be punched on tape for later accumulation of additional experiments.

Regression coefficients are computed from the X'X matrix and X'Y vectors, as well as the inverse matrix, if desired. Inversion time is 30 minutes for a 15 x 15 matrix, and another 15 minutes is required if the inverse matrix is to be typed out. The program also types out the sum of squares of the deviations of the responses from their mean value and the sum of squares of the residuals.

Additional numbers for computing an analysis of variance are stored in memory but not typed out. A memory interrogator is provided to type out these numbers or other programs may be written to be read into the memory to perform further operations on the data. An Intercom 1000 subroutine is included to assist in the preparation of tapes of input data.

Submitted by: Dr. A. L. Squyres
E.I. du Pont de Nemours & Co., Inc.
Eastern Laboratory
Gibbstown, New Jersey

HARLEY, ELLINGTON AND DAY, INC.

ABSTRACT OF USERS PROJECT NO. 178

TITLE:

Triangulation

CLASS:

2

MODE:

Intercom 1000 (D.P.)

ORIGINATOR:

Harley; Ellington & Day, Inc.

DATE:

September 22, 1958

Given the base line length or coordinates and angles, the program will compute sides of triangles and its coordinates. A maximum of 15 triangles may be entered in one computation.

The program is written in Intercom 1000 double precision. Machine language arc tangent subroutine is used. No adjustment of angles and lengths is provided in the program so that angles must be adjusted first before entering into the machine if the sum of angles is not equal to 180 degrees.

Output data are triangle's reference no., length of sides and coordinates. Compute and typeout require 26 seconds per triangle.

HARLEY, ELLINGTON AND DAY, INC.

ABSTRACT OF USERS PROJECT NO. 179

TITLE:

Slab Volumes

CLASS:

1

MODE:

Intercom 1000 (S.P.)

ORIGINATOR:

Harley, Ellington & Day, Inc.

DATE:

September 18, 1958

With the following input data; slab end thicknesses, beam spacings, span lengths and deflections, vertical curve and camber corrections, flange dimensions and number and type of beams, the program will compute volumes in cubic yards of slabs containing any number of beams.

Structures may be of three types: (1) Suspended span or simple support span, (2) beams with one cantilever end, (3) beams with two cantilever ends.

The volume of each slab is typed out.

Input data requires 3-5 minutes, depending on number of beams. Output requires 30 seconds per beam.

ABSTRACT OF USERS PROJECT NO. 180

TITLE

ROOM HEAT LOSS

CLASS

2

MADE:

INTERCOM 1000 SP

ORIGINATOR:

CONSOER, TOWNSEND & ASSOCIATES

DATE:

OCTOBER 1, 1958

This program processes the basic data for the computation of heat loss from a room. The input data consists of areas, temperature differences, infiltration lengths, ventilation volumes and coefficients. Computed and typed out is the transmitted heat loss, infiltration heat loss, ventilation heat loss and total heat loss. Data for up to forty rooms may be loaded at one time.

The computation and typeout time is about 30 seconds per room.

At the completion of the program the program and data are intact,

ABSTRACT OF USERS PROJECT NO. 181

Title:

GEOLETRIC PACKAGE

(Intersection Two Lines)

(Intersection Line and Curve)

Class:

1

Mode:

1000-D

Originator:

J. S. WATKING CONSULTING ENGINEERS

Date:

September 18, 1958

This is a set of two programs which solve similar problems, the intersections of two lines and the intersection of a line and a curve.

Given the coordinates of a point on each of two lines and the bearing of each line the program solves for the coordinates of the point of intersection and the length of the two intersecting lines.

Given the coordinates of the radial point, the length of radius of a curve and the bearing and coordinates of a point on a line the programs solves for the intersection coordinates of the line and curve and recomputes the radius for a check.

No auxiliary equipment needed.

Subroutines used: Sine, Cosine, Square Root and Angular Conversion

PROGRAM ABSTRACT

Program: Detailed Pier Analysis (S-3)

Class: 2

Originator: Parsons, Brinckerhoff, Hall & Macdonald

October 10, 1958

This program analyzes a single story rigid frame pier having constant moment of inertia in all members. The program computes the final distributed moments at all joints and moments and shears at up to five additional points in each pier cap for dead load, temperature variation, horizontal wind load, and up to 13 different live load conditions.

This program was written primarily to be used with U.P. #100. The influence moments obtained as output from U.P. #100 (or equivalent influence values obtained from other sources) must be entered into this program as input data. In addition, the lengths of each pier member, the position of each stringer on the pier, the horizontal wind load, temperature variation and either the stringer reactions for each loading condition or the value and location of the wheel loads above the stringers.

The program is written in Intercom 1000 S.P. and completely fills the interpretive memory.

HARLEY, ELLINGTON and DAY, INC.

ABSTRACT OF USERS PROJECT NO. 183

TITLE:

Coordinate Transformations

CLASS:

2

MODE:

Intercom 1000 (D.P.)

ORIGINA TOR:

Harley, Ellington and Day, Inc.

DATE:

October 6, 1958

This program will find the coordinates of any point referred to coordinate axes which are rotated and/or translated with respect to the original axes.

The program also provides for cases where the direction of the axis is reversed, and where the angle of rotation is measured to either coordinate axis.

Input data consists of the angle of rotation of the coordinate axes, measured counterclockwise in degrees, minutes, seconds; the coordinates of the point of translation of the axes; and the coordinates of each point (Maximum: 22).

Type out consists of the coordinates of the original point and the coordinates of the point referred to axes rotated and/or translated with respect to the original axes.

Typeout time is 12 seconds per point. No auxiliary equipment is required.

ABSTRACT OF USERS PROJECT NO. 184

TITLE: Slab Thicknesses and Screed Elevations

CLASS:

MODE: Intercom 1000 Single

ORIGINATOR: Harley, Ellington & Day, Inc.

DATE:

Given minimum slab thickness, controlling slab end thicknesses, elevations, vertical curve data, width of bridge, weights of beams, sidewalks, railings and forms, length of beams and moment of inertia of beams, the program computes slab thicknesses and screed elevations. Slab thicknesses are rounded off to the nearest 1/8 in.

The program is written for a continuous girder bridge with intermediate hinges. There is no limit for the number of spans. However, some work has to be done manually, that is, the bridge has to be divided at its hinge points and feed back into the machine separately according to the sequence of pours. It can also be used for simple supported bridges, but not for continuous girder bridges.

The program consists of three parts. Part I is for suspended spans or simple supported spans, (type I), moment of inertia of beams could be constant or variable and camber is allowed. Part II is for cantilever spans with one overhanging end (Type 2) moment of inertia of beams must be constant, no camber is allowed. Part III is for cantilever spans with two overhanging ends. Beams and load must be symmetrical about its centerline, constant moment of inertia and no camber. In Type I beams may have circular camber or straight line camber of variable length. If circular camber is called for the program will compare this value with the sum of vertical curve correction and dead load deflection. If this value is smaller, computer will take the larger one as the beam camber except for zero camber.

The output format is shown on the attached sheets. Beams are divided into 6 equal parts between their supports. Therefore, 7 points will be typed out for Type 1, 8 points for Type 2 and 9 points for Type 3. For a 3 sectional lines type-out, the approximate time will be:

Type 1 - 8 minutes
Type 2 - 8.5 minutes
Type 3 - 9 minutes

HARLEY, ELLINGTON AND DAY INC.

ABSTRACT OF USERS'PROJECT NO. 185

TITLE: Interchange Ramp (Pavement Profiles)

CLASS: 2

MODE: Intercom 1000 Single

ORGINIATOR: Harley, Ellington and Day, Inc.

DATE: September 22, 1958

Given pavement width, point of rotation, vertical curve data and horizontal curve data, the program computes elevations along the left and right edges of the pavement and the joint line for every even station, or every even increment and any desired stations.

The program is written for an interchange ramp on both vertical and horizontal curves. The number of PI's for the vertical curve is limited to 9. Number of transitions, superelevations and normals is limited to 18. The point of rotation is limited at pavement edges, either left or right. The plan grade elevations are assumed to be the right edge elevations before rotation. Pavement crown is modified parabolic crown, i.e. y = .03354 x 3/2. Transitions are vertical reverse curves.

Input consists of pavement widths, starting and ending stations, point of rotation, first even station, increment, stations and rate of superelevations where normal, transition or superelevation start or end, and the vertical curve data of the plan grade, i.e. P.I. station, P.I. elevations, length of vertical curves and grades.

The output format is shown on the attached sheet. The first column is stations (in sequence) which are the starting station, first even station, stations with equal increment after the first even station, stations where transition, superelevation or normal start or end and additional stations which are required but not covered in the regular increment and the last station. The second column is the corresponding plan grade elevations. The third, fourth and fifth columns are elevations along left pavement edge, joint line and right pavement edge.

Data input requires 5-8 minutes. Calculation and typeout time depends on the number of stations and length of ramp, for a 1000 ft ramp and 100 ft increment, it takes about 6 minutes. No auxiliary equipment is used.

ABSTRACT OF USERS' PROJECT NO. 186

TITLE: Pier Design (Pier Cap Girder)

CLASS:

MODE: Intercom 1000 Single

ORIGINATOR: Harley, Ellington and Day, Inc.

DATE: September 22, 1958

Given detailed dimensions and loadings, the program computes with no sidesway correction, the frame and beam moments and shears under different loadings.

The program is written for a bent of up to 5 spans with constant or variable column heights, isolated or continuous footings, and cantilevers at both ends. Members must be constant moment of inertia and the columns must be either fixed or hinged at bottom.

Input consists of k's of members and girder spans, center to center distance, and magnitude and location of vertical loads. A maximum of one (1) uniform dead load and three (3) concentrated dead or live loads or both can be entered in each bay. Load distances are measured from the left support.

The output format is shown on the attached sheet. The first typeout is the moment and shear at the left cantilever end (joint). If no cantilever, zeros will be typed out. Next, the beam moments of each span for three different loadings, i.e. maximum positive, maximum negative at left end and maximum negative at right end, and beams shears of each span for two different loadings, i.e. maximum shear at left end and maximum at right end are typed out. The last is the moment and shear at the right cantilever end. Beam moments are moments at left end of beam, moments under each concentrated load point, and moment at right beam end. Beams shears are shears at two ends. No column face moments and shears will be typed out.

Distribution factors are calculated by machine and four cycles of moment distribution are used. The program does not consider horizontal forces and sidesway. It also does not calculate shrinkage and differential settlement effects.

Data input requires 8-10 minutes. Calculation and typeout time depends on the number of bays - for a 4 span pier it takes about 18 minutes to compute and 5 minutes for typeout. No auxiliary equipment is used.



Refining Department

USERS' PROJECT NO. 187

ABSTRACT

Mass Spectrometer Analyses Computations
The Ohio Oil Company, Project No. 5

Apolication

The purpose of this program is to compute the quantity of hydrecarbens present in a mixture containing not more than twenty-seven components.

Input

The input consists of stream identification, peak height identification numbers, attenuation factors, and galvanometer divisions. These values are punched in binary coded decimal tape by an on-line flexowriter actuated by an analog-to-digital converter.

Output

The typeout for a given sample consists of:

- 1. Stream identification
- 2. Hydrocarbon identification numbers
- 3. Partial pressures
- 4. Mol. percents
- 5. Weight percents
- 6. Liquid percents
- 7. Total calculated pressure
- 8. Total observed pressure
- 9. BTU/cu. ft.
- 10. Molecular weight
- 11. Specific gravity liquid
- 12. Specific gravity gas
- 13. A.P.I. gravity
- 14. Density





USERS' PROJECT NO. 188

CLASS 1

E. I. du Pont de Nemours and Co., Inc.
RANDOM NUMBER GENERATOR FOR DAISY 201 -

ABSTRACT

Given a double-precision floating-point number between zero and unity, generate the next number in a sequence of pseudorandom numbers within this range according to the modular method. By feeding the output back to this subroutine, extended portions of a sequence of pseudorandom numbers can be so generated.

USERS! PROJECT NO. 189

CLASS 1

ABSTRACT

SI(x), CI(x), CIN(x).

This subroutine may be used to calculate the sine integral, and CIN (x), which is the cosine integral, series portion only, for any value of x, and the cosine integral for any value of x greater than 0.

USERS' PROJECT NO. 190

CLASS 1

ABSTRACT

IN I_o (x)

This subroutine may be used to calculate the natural logarithm of I_o (x) (= J_o (ix)) for any value of x.

USERS' PROJECT NO. 191

BENDIX RADIO DIVISION

CLASS 1

ABSTRACT

This program, as set up, will sort 100 numbers which are located in locations 400 to 499, will set them up in ascending numerical order in locations 500 to 599, and type them out in the process. The time required for 100 numbers is 17 minutes, 20 seconds.

The numbers are divided in 10 primary groups of 10 each, and the smallest number is picked from each group to make a economy group of 10. The smallest number from the secondary group is picked and sond into lime 500, and is then replaced by the second smallest number from the primary group from which it came. This process continues until all numbers are picked. Numbers in lime 100 are replaced by 88,10000.

Variations of this program may be made to sort out more, or less, numbers; to vary the locations used; or to arrange the numbers in descending order.

USERS! PROJECT NO. 192

CLASS 1

ABSTRACT

INDEX REGISTER OPERATIONS

DAISY APPENDIX SUBROUTINE #008

This subroutine enables the transfer of a number from an index register to the A register, or vice versa, also enables the B, D & L registers to be set by a single command.

E. I. DU PONT DE NEMOURS & COMPANY, INC. Engineering Department MECHANICAL DEVELOPMENT LABORATORY 101 Beach Street

Users' Project No. 193

TITLE: Regression Programs for the Bendix G-15 D Computer

CATEGORY: #2

EQUIPMENT & MODE OF OPERATION: G-15 D & Daisy

PROBLEM STATEMENT:

This series of computer programs will carry out the necessary calculations for a regression analysis. The details of each program are described in its respective write-up. The descriptive titles of the programs are:

Prog. No.	Prog. Title
(1-1-1)	Average, Standard Deviation & Sum of Squares
(1-2-1)	Regression Matrices for Mean Normalizer & Quadratic Expander
(1-2-2)	Optional Standard Deviation & Sum of Squares Normal- izers, & Linear & Polynomial Expanders for (1-2-1)
(1-3-1)	Symmetric Matrix Inversion Routine
(1-4-1)	Output of Symmetric Matrix
(1-5-1)	Calculation of Regression Coefficients
(2-1-1)	Regression Analysis
(2-2-1)	Residual Computation, Mean-Normalizer & Quadratic Expander
JNM:SJ8/jcb	

JNM:SJ8/jcb -1TITIE:

EARTIMORK TABUTATION

CLASS:

2

MODE: ORIGINATOR:

Intercom 1000 Double Precision

ORIGIMATOR: Edwards and Kolcey, Engineers

DATE:

October, 1958

This routine will compute earthwork in areas where cross sections are necessary. The input consists of the station, the planimeter readings for the cut and fill sections, the planimeter scale, a factor for cut and a factor for fill (if required) and initial volumes of cut and fill, if any.

The output consists of the distance between stations, the average and areas of cut and fill, the volumes of cut and fill between stations and the cumulative volumes.

The routine computes the end area at Station N and then the distance to Station N+1. If this distance is positive, (N+1 less than N) zero is used as the distance between stations. Consequently, stations back and ahead or special sections right and left can be handled in one pass. The program roes on to compute the areas at Station N+1 and the volumes and adjust the volumes if required. Mext it transfers the areas of Station N+1 to the locations used for Station N and treats Station N+2 as Station N+1. A station flag is used to terminate computation.

Most designers enter the planimeter reading resulting from say 4 passes around the section and enter a planimeter scale 1/4 of the true value, which saves some additional time.

The total time required to type in, compute, and type out averages a little less than a minute per station. The areas and volumes are typed out to the nearest tenth and distances and stations to the nearest thousandth.

Prog. No.	Prog. Title
(2-2-2)	Optional Expanders & Normalizers for (2-2-1)
(2-3-1)	Confidence Interval & Predictions for Mean-Normalizer & Quadratic Expander
(2-3-2)	Optional Expander & Normalizer for (2-3-1)

The programs are identified by a three digit numbering system (A-B-C) as follows:

- Denotes the program group
- Denotes the phase in a group of programs
- C Denotes the version, or option, for a specific program

INPUT DATA:

The form of data input required for these programs is described on Page Two of the program (1-1-1).

OUTPUT DATA:

The output of each program is described in its respective program write-up.

LIMITATIONS:

There is no restriction on the number of data points that can be handled by these programs.

These programs will handle five response variables and fifteen expanded input variables.

Prepared By:

J. N. Miller

S. J. Slough

S. J. Slough

JNM:SJS/jcb

Titler

Date:

DESIGN OF SPREAD FOOTING STUB ABUTHENT

Olana: Modo: Originator:

Intercom 1000 Single Precision Edwards and Kelcey, Engineers September, 1953

Civen the stem dimensions, footing thickness and various leading conditions, this program computes the required stem steel at the top of footing and, for four leading groups, computes the distance of the resultant of forces from the toe, the final footing dimensions (tee, hoch and overwall width), the toe pressure, heal pressure, factors of safety against sliding and overturning, the required toe steel and the volume of concrete. The Standard Specifications for Highway Bridges, A.A.F.H.O. 1957, were used.

The portion of the program which designs the footing begins with minimum overall width and head dimensions and increments either the toe or head or both wrill either all the allowable conditions are satisfied or the maximum limiting dimension of overall footing width is reached. This limiting dimension is equal to the height of abutaent from the bottom of footing to the top of backfall. Each increment is equal to six inches and no dimensions are decremented. He provision has been made for incrementing the footing thickness. If any of the allowable conditions have not been satisfied and incrementing has reached its limit or there is a negative toe or head pressure, a zero volume of cenerate is typed out and computation halts. If the allowables have been satisfied and the pressures are positive, the volume of cenerate is computed and typed out followed by the required too steel. In the computations the effect of any fill over the too is neglected. Reinforcing steel in the heal is not computed as the heal will usually be quite small. All computations are based on a unit length of abutanont.

Input data consists of the equivalent fluid pressure, height of equivalent uniform surcharge, height of backfill, stem dimensions, thickness of footing, DL reaction, horizontal and vertical LL reactions, cover for stem steel, coefficient of friction at base, allowable soil pressure, for and j for reinforced concrete dassign. Provision has been made to allow the designer to charge any of the constants should be desire to do so. The constants are the unit weights of soil (backfill) and concrete, the allowable factors of safety and soil bearing pressure, the minimum widths of heel and footing, cover for toe steel and the allowable bond stress. The values of those items are shown on the input sheet.

The program write-up contains both a sample input and output sheet. The typeout is in the following order: required stem steel area and perimeter, the limits (1/3 W and 2/3 W) of \bar{y} (the distance of the resultant of forces from the toe), \bar{y} for the four leading groups, the final footing dimensions (too, heel and overall width), the toe and heel pressures and factors of safety (sliding and overturning) for the four groups, volume of concrete and required toe steel area and perimeter.

Data input requires up to 5 minutes. Computation and typeout requires from 5 to 10 minutes. No auxiliary equipment is used.

Users' Project No. 196 Class 1

E. I. duPont dellemours & Co. Eastern Laboratories

ABSTRACT

AUTOPOINT 24

Autopoint 24 is a fixed-point double-precision machine language programming system. All arithmetic operations are carried out with numbers which are scaled by a factor of 2-24. This is equivalent to carrying out decimal computations in a fixed-point system with seven decimal places to the left of the decimal point and ten places to the right. This is an adequate range and degree of precision for most technical computations.

The system provides sub-routines for multiplication, division, fixed-to-floating-point conversion, floating-to-fixed-point conversion, punching paper tape, square root, exponential functions, and logarithms. More subroutines may be added at a later date. The system also includes the basic package of the Standard Program Preparation Routine (PPR) with a few modifications to make it more suitable for the Autopoint system.

The programming for the basic Autopoint system occupies Lines 00, 02, 03, and 04. The PPR programming occupies Lines 05, 15,16, and17. Any program written using Autopoint 24 may use Lines 06-14 for either program or data and additional lines if necessary (since the PPR portion is not normally used during the execution of a program except for punching tape.) When any of these lines is selected for the execution of program, it is copied into Line 01, which is then used as the active command line. Sub-routines are set up to return to Line 01 after they have been executed.

Since the program is written in machine language and executed in:Line O1, any machine language command is a valid Autopoint command, and the system retains all of the versatility of machine language programming. By following certain conventions in the use of sub-routines, however, most of the troublesome details of machine language coding may be minimized. Addition and subtraction are normally carried out in the PN register without the use of subroutines, since no scaling is involved. The operations which involve the use of sub-routines may be carried out by executing the conventional commands in the following list. The address \$8.YT means the double-precision number in words TT and TT + 1 of Line SS. TT must be an even number. The next Autopoint command is taken from word NN.

ABSTRACT

Class 1

USERS' PROJECT NO. 197_

Suggested Revisions to Applications Section Project No. 45

Changes on the attached sheets are suggested for modifying the "Scattering Parameters from Unit Cell" program to accomplish the following results:

- (1) Removal of the restriction of the angles α, β, δ to values greater than or equal to 90° (change 03.46).
- (2) Typing out the values of $(\sin \theta/\lambda)^2$ to four decimal places (change 04.31).
- (3) Computation of $d = \frac{\lambda}{2 \sin \theta}$, and type-out of this value following each value of $(\sin \theta/\lambda)^2$ (changes in line 04, line 13, line 14, and loader).

Submitted by:

Nylon Research Division E.I. du Pont de Nemours & Co., Inc. Experimental Station Wilmington 98, Delaware

Abstract of Users Preject Mo. 198

Title: Rigid Frame with Hingre

GLASS

Mode Intercom 10008

Originator Tudor Engineering Company

Unta September 1928

Given the dimensions and moments of inertia of the various elements of a single story rigid frame with intermediate binges and cantilevers, the program will compute complete influence ordinates for uniform and concentrated loads. It will also compute uniform dead load values.

2

The rigid frame which must not exceed five spans, may have variable span lengths and column heights, but members must be primatic. The columns each may be fixed at the top and bottom, fixed at the top only or himms at the top. The values computed for each loading condition are as follows:

(1) Noments at the top and bottom of each column, at the left and right of each joint, at some point (p) in each span, (2) shours at the left and right of each joint, (3) reaction at the top of each column, (4) horizontal reaction.

The loading conditions computed are as follows: (1) Unit uniform load in each span, including cantilevers, (2) Concentrated loads in each span. The locations of these loads are variable; however, the program tape is est to every tenth point. Cantilever spans are loaded at their extreme with a unit concentrated load. (3) Dead load values for concentrated loads at the end of the cantilever spans. (4) Dead load values for uniform load on ell spans, including the cantilever spans.

Moment distribution is used to calculate the joint moments. Static to used to calculate the coments in the span, the shears, and reactions. It is not possible to compute values for temperature and shrinkage forces and horizontal loads with this program. There are dependent upon the friction of the hinge and the vertical load present at the hinge.

The time required for entering the input data is about ten minutes. The running time varies with the number of spans. A three span analysis regulars about one hour and thirty minutes.

REVENUE BOND AMORTIZATION

USERS PROJECT NO. 199

CLASS I

INTERCOM 1000 S

PALMER AND BAKER ENGINEERS, INC.

October, 1958

PROGRAM ABSTRACT

This program prepares amortization tables for revenue bonds computing interest, retirement penalties, reserve funds, and bonds retired each year, as well as "coverage" for the bond issue.

Input of annually variable data is by punched tape from a Flexowriter or "add-punch" but this may be easily modified for typewriter input. Input of fixed data is either by tape or typewriter.

Amounts are computed to nearest dollar for bond issues up to \$100,000 and bond retirement in increments of \$100. However, any decimal scale factor may be assumed.

The term of the bond issue may be up to 100 years. Three sources of revenue are permitted, as well as annual maintenance (and operation) expenditures, varying retirement penalty rates, reserve fund of any number of years interest and maintenance costs, and a special reserve fund.

After the first year specified for interest payment, this payment will be shown, provided funds are available.

After the first year specified for bond retirement, bonds will be retired according to the funds available, but not to the extent that interest could not be paid the following year if net revenues are declining. Excessive decline in net revenues will cause an error stop.

PALMER & BAKER ENGINEERS. INC.

DESIGN COMPUTATIONS

SHEET NO.____

MADE BYCharlton DATE 10-1-58

BUBJECT MATTER PROGRAM FOR BENDIX G-15D COMPUTER

CHECKED BY____DATE_

Abstract of Users Project. No. 200

TITLE: THREE-CURVED LOOP RAMP GEOMETRICS

CLASS:

2

MODE: Intercom 1000 (T.A.M. 24A & 30)

ORIGINATOR: PALMER & BAKER ENGINEERS, INC.

DATE: October 1, 1958

This program takes design features and computes the trigonometric and geometric features of the three-curved loop ramp. Input includes the location of the two roadways connected by the ramp by means of the coordinates of their point of intersection and their bearings. Distances from this point of roadway intersection to beginning and end of ramp and the curve radii define the ramp. The input is completed with distances from the roadway stationing lines to ramp stationing line at the ramp ends.

The output consists of curve data for the three curves, stationing of the ramp including equation stations of the roadways, coordinates of curve definition points and bearings of curve radial lines.

The program solves the triangle formed by the centers of the three ramp curves and proceeds to develop the delta angles of the curves. From these delta angles and the given radii the remaining output items are computed.

A special feature is the form of presentation of bearings. Both input and output handling of bearings is in the form of degrees, minutes and seconds.

Limitations to the program are that a scale drawing must be prepared prior to development of input data; the sketch on the input sheet must be oriented with scale drawing; the roadways must be straight from their point of intersection to beginning and end of ramp; the radii relation and delta angle size must conform to one of thefollowing categories: Case I - Radius of central curve is shortest and delta angle of central curve is less than 180 degrees; Case II - Radius of central curve is shortest and delta angle of central curve is greater than 180 degrees; Case IV - Radius of central curve is longest and delta angle of central curve is less than 180 degrees. The program will not compute a loop with delta angle of central curve equal to 180 degrees.

Subroutines used: square root; sin, cos and arc tan

Auxiliary equipment used: none

Computation time: 12 minutes

ABSTRACT

Class 1

INTRODUCTION

The purpose of this subroutine is to perform the serial addition (updating) of lines 18 and 19. Although the basic subroutine is designed to update all 108 words in a line, it may be modified to update:

- 1. Only even locations
- 2. Only add locations
- 3. Every other even location and every other odd location.

Experience in designing and preparing data processing systems for the Bendix G-15D has shown us that a fast flexible updating subroutine would be the most useful and most used subroutine in the data processing programmer's library. Uses will include Payroll records, Inventory files, Production control files, Sales information, etc. The enclosed subroutine is the result of many false starts, discarded because they were either too slow or too inflexible. However, the result is felt to be both fast enough and flexible enough to meet most any needs.

No responsibility is assumed by the Clary Corporation for any errors, mistakes or misrepresentations that may occur during, or due to, the use of this subroutine.

MECHANICAL DIVISION



PAGE 1 OF 1
DATE 10/24/58
LINE 00

G-15D PROGRAM CA 1 TEST ROUTINE

PREPARED BY H.J. Chiat

ABSTRACT

Users'Project No. 202

The function of the CAT routine is to provide a means for checking the punching and reading operation performed by the O26 or O24 IBM Key Punch and the Bendix CA-1 Equipment.

The basic package is stored and operated from Line 00. Lines 18 and 19 are used for working storage and for input and output to the Card Emilment. The AR register and all four word lines are used by this routine. Source 29 is used as a source for zeros.

- Th. routine has three modes of operation:
 - a. PUNCH the Number Track on the cards.
 - b. READ THE STACK of cards containing the Number Track and type out the contents of the stack.
 - c. READ ONE CARD and type out its contents.

General Purpose Geometry Program Usera Proj. No. 203 Category, 1 Abstract

This program provides a simple, yet flexible, tool for solution of geometrical problems involving straight lines and circular curves. It is based on the use of coordinates and bearings to define location of points and direction of lines. Several independent programs are contained in memory together, and any may be selected for use alternately. Printed output forms for all programs are provided. The following programs are included:

- 1. Unadjusted traverse
- 2. Inverse traverse
- 3. Inverse calculations
- 4. Intersection of two lines
- 5. Intersection of line and arc
- 6. Intersection of two arcs
- 7. Horizontal curve data
- 8. Miscellaneous right triangles

Input data for a number of problems of the same type can be held in memory in sequence. Coding is in Daisy 201.

> Prepared by: Reynolds, Smith and Hills Architects and Engineers

227 Park Street

Jacksonville, Florida

J. STEPHEN WATKINS

CONSULTING ENOMIEERS
446 EAST HIGH
LEXINGTON, KENTUCKY

ABSTRACT

Intercom 1000 D (TAN 24A)

Curved Bridge - Elevetions on Radial Grid

This program computes stations, deck elevations, and radial offsets from the centerline of roadway, at points determined by the intersection of girders and/or curved longitudinal lines with a series of radial lines whose spacings along the centerline of roadway are known. Deem or are lengths between the centerlines of piers and abutments are also computed.

The program must be used in conjunction with Users Project No. 88, Readway Elevations for Bridges on Circular Curve, originated by Delsum, Cather and Company. Tape punched during Part I of U. P. # 88 is used as input for the radial grid program.

Limitations are in general identical to those in U. P. # 68; 1.e., consentric curves, 13 stringers, 8 curved lines. However, this program computes points on a beam along the entire length of the bridge, before going to the next beam, rather than working one span completely. This fast imposes the following limitation:

(No. Beams + No. Curves) x No. Spans & 52

If a particular problem exceeds this limit, one or more spans must be treated as a separate bridge.

Input includes the number of girders, curved lines, spans, and grid lines; vertical five and superelevation data; radial distances from conterline of roofing to profile grade line, each surved line, and are of each girder (chord); crossing station at each pier and abutment; and spacing of grid lines along centerline of roadway.

Any grid point not on the structure is flagged by a type out of its station only. Execution time for a 4-span bridge with 4 girlers, 3 curved lines, and 25 grid lines, is approximately 1 and 1/4 hours, including typing data and reading data from tape.

No auxiliary equipment is required.

PALMER & BAKER ENGINEERS, INC.

DESIGN COMPUTATIONS

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MADE BY Charlton DATE 11-1-58

SUBJECT MATTER PROGRAM FOR BENDIX G. 190 COMPUTER CHECKED BY DATE

Abstract of Users Project No. 205

Title: THREE_CURVED RAMP GEOMETRICS

Class: 2

Mode: Intercom 1000 (T.A.M. 24A & 30)

Originator: PALMER & BAKER ENGINEERS, INC.

Date: November 1, 1958

This is an outer connection ramp consisting of a curve to the right on each end and a curve to the left, partially encircling an inner loop ramp, in the central portion with tangent sections between the curves.

The input includes the coordinates of a point on each of the two roadways connected by the ramp, stations of the points, bearings of the roadways, radius or degree of the ramp curves, distances along the roadway stationing lines to points opposite the ends of the ramp, and distances from the roadway stationing lines to the ends of the ramp. Geometric features of the inner loop required for input data are coordinates of the center of a loop ramp curve, the radius of that curve, the bearing of P.C.C. radial line and a chord distance from the P.C.C. to the location of minimum distance between the ramps. The value of this minimum distance completes the required input.

Output consists of the curve data for the three curves, stationing of the ramp including equation stations of the roadways, coordinates of all curve definition points, coordinates of the center of any roadway curves, bearings of ramp P.C. and P.T. radial lines and bearings of ramp tangent lines.

The method of solution is to locate the three ramp curve centers by coordinates, and compute a line tangent to two curves by means of triangles at each end of the ramp. The ramp curve delta angles are found by intersections of azimuths and adding or subtracting angles. From the delta angles and radii are developed the curve data and other output information.

Special features are entry and exit of bearings in form of degrees, minutes and seconds and roadways which can be tangent or curved in either direction.

Limitations are that a scale drawing must be prepared prior to development of input data; the sketch on the input sheet must be oriented with the scale drawing and only simple circular curves are computed.

Subroutines used: square root; sin, cos and arc tan

Auxiliary equipment used: none Computation time: 15 minutes

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK
WELLS 8 0600

Users' Project No. 206

ABSTRACT

Title:

Tape Preparation Routine for A.S.P. No. 32

Class:

2

Made:

m.l., a.p., G-15D

Originator:

Lockwood, Kensler and Bartlett, Inc.

Date:

November, 1958

This routine prepares a required input tape on the G-15D for the Traverse Closure and Adjustment Program (A.S.P. No. 32.)

With the routine in the G-15D, for each course the type-in consists of:

- 1. Distance (8 digits) sign tab
- 2. Sign tab angle (9 digits) sign
- 3. Tub s

The computer types out the same contents for a proof reading in the following form; for an example:

530.569

-74.06.36.00-

The following three methods of corrections and a code to punch one block (up to 27 courses) are provided.

1. v tab s

Erase before tab s

2. x tab s

Erase after tab s

3. y tab s

Erase all

4. z tab s

Punch tape and type check sum

PROGRAM ABSTRACT

Users Project No. 207

Class 2

PARCEL LENGTHS, AZIMUTHS & AREAS FROM COORDINATE DATA

Given a closed traverse, defined by the coordinates of the P.I.'s, the program computes the length and bearing of each course and the enclosed area of the traverse.

Input

The input data includes the Project No. and the Parcel No. (or traverse No.), to be used in identifying the output; and the north and east coordinates of each P.I. of the traverse. The traverse may have fifty courses.

Output

The first line of output is the Project No. and the Parcel No. and the Program No. (116). The succeeding four word lines are the north and east coordinates, and the forward course length and bearings in degrees, minutes and seconds.

Specifications

The program is written in Daisy and requires the Daisy Appendix. Type-out is fixed point.

Computing and type-out time is approximately 16 seconds per course.

MEISSNER ENGINEERS, INC. Chicago, Illinois

U. S. APMY ECONOMIC DISPRICE, LOS ANGELES CORES OF FEGUREERS

751 South Figueroa Street Los Angeles 17, California

Users' Project No. 208

Class 1

DORROW PIT QUANTITIES

Intercom 1000 SP Program for Bendix G-15D Computer

Progress Abstract

Problem Statement

This program computes the quantity of material excavated from a borrow pit, given the cross-section data for both the initial and final surveys. Stations at which these cross-sections are taken need not be coincident. The program will handle a borrow pit of 99 stations or less, and 99 points or less along each line. The only limiting conditions are:

(a) When final and initial surveys are at the same station, all points of the final survey must lie within the extreme limits of the initial survey at that station. (b) When a final survey is not coincident with an initial survey, all points on the final survey must lie between lines drawn between the extremities of the two adjacent initial surveys.

Input Data:

Stations, elevations or rod readings and offsets.

Output Data:

Station, area excavated for each station, volume excavated between successive stations and the

total volume excavated.

ABSTRACT

Users' Project No. 209

PROGRAM TITLE:

"Twenty Questions"

TYPE:

Restricted (Demonstration)

CATEGORY:

Class 1

EQUIPMENT AFFECTED:

G-15D

SUBROUTINES USED:

None

This single line program plays a numerical version of the game "Twenty Questions".

PREPARED BY:

University of Delaware

DATE:

November 25, 1958

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

Users' Project No. 210

ABSTRACT

Title:

Lines and Circle

Class:

2

Mode:

Intercom 1000 D (24-A)

Originator:

LOCKWOOD, KESSLER & BARTLETT, INC.

Date:

November, 1958

The program consists of five independent parts.

PART I: INTERSECTION OF TWO LINES

The coordinates of two points are given for each straight line. Determine the coordinates of intersection of two lines, and the distances from four given points to the intersection.

Computation time: 1 min. 10 sec.

PART II: INTERSECTIONS OF LINE AND CIRCLE

The coordinates of two points on a straight line, the coordinates of the center of a circle, and the radius of the circle are given. Compute the coordinates of the intersections of the line and circle. Computation time: 35 sec.

PART III: DISTANCE AND BEARING

The coordinates of two points on a straight line are known. Compute the distance between the points, bearing, and azimuth of the line. Computation time: 1 min. 25 sec.

PART IV: HEIGHT OF TRIANGLE

The coordinates of three corners of a triangle are given. Compute the height of triangle and the distance from first corner to the foot of perpendicular.

Computation time: 30 sec.

PART V: TANGENT, ARC AND SEGHENT

The radius of a circle and the angle at the center of the circle are known. Determine the tangent distance, the arc length, and the area of segment.

Computation time: 1 min. 55 sec.

QUADRILATERAL ADJUSTMENT

	USERS' PROJECT NO. 211 Engineers
File No.	A Architects
Part of the second second second second	a ·
Fined Point Line C Sin-Coa Line 1 Log Routing Line 2	D E C
OBSERVED DATA	COMPUTED DATA
Angle Location	
a 140 h 142	Anale &
u 11/13	
i 146	
1 150 4 15:: 4 15::	australia de de la companya del companya de la companya del companya de la companya del la companya de la compa
L 15h	3ide AB
The same of the sa	AD BC
•	CD
*Anown wide	Diagonal AC

ABSTRACT

This program is coded for the Bendix G-15D in Daisy 201, using the angle conversion subroutine (on the program tape) and the following Daisy Appendix: Sine-cosine, fixed point typeout, and Log to the base 10. The typeout is fixed point, double precision. The running time including typeout is four minutes and thirty seconds.

The program adjusts quadrilaterals to an accuracy depending upon survey accuracy, satisfying both geometric and trigonometric conditions. With the length of one side known, this program computes the lengths of the other three sides and the lengths of the diagonals.

ABSTRACT

WILSON & COMPANY ENGINEERS

SALINA, KANSAS

LISTERS—INTERCOM 1000 DOUBLE PRECISION AND SINGLE PRECISION

These programs will list the commands and/or numbers for all programs written in Intercom 1000 Double Precision and Intercom 1000 Single Precision. It is also possible to stop listing commands and start listing numbers in the same sequence (or vice versa) in this program.

p0551:00// s0691	:00// s		
0551800// s	• •	scf06 7	000 0// s
05: 1893// s		05: 100	ċ // s
1598 539 s 53.9	00000000000	1393	5414 s 54.140000000000
1900 0691850//	S	1900	0691;;50// s
069158: // s		069137	3// s
,,,			
9CO 1007000		1400	53.10000000000
901 1047100			
902 1997200		1402	53.1.00000000000
903 1004/15			
904 7 02314		7.404	53.30000000000
905 802209			
006 1024215		1406	53.40000000000
907 24114			
903 15 ~009		1403	-51.100000000000
909 4314			
910 1004913		1410	-51.100000000000

P. O BOX 28 SALINA, KANSAS

631 E. GRAWFORD AVE. TAYLOR 7-4407

Users' Project No. 213

ABSTRACT

BRIDGE UNDERCLEARANCE

Class 2

Intercom 1000D

2 December 1958

- 1. Definition of Problem. To compute the vertical clearance under a grade separation structure at eight critical points, such as the intersections of the two fascia lines with two edges of pavement and two shoulder lines. The clearance is given from "low steel" to profile grade of the road under the bridge. Haunches, either straight or parabolic, are taken into account by the program. Bearing lines need not parablel the road below, but must parallel each other.
- 2. Input. Thirty-two words of data are required, including data for horizon-tal and vertical alignment on the upper and lower roads; angle between forward tangents; angle between bridge bearing lines and road below (in the same quadrant); distances from center line of lower road to pavement and shoulder edges and to end of span; distances from end of span to beginning of haunch, to PT of this haunch and PC of the other haunch and end of that haunch; depths from top of roadway to "low steel" for each haunch and between haunches; and crowns from upper profile grade to top of roadway at each fascia line.
- 3. Output. Eight lines of five words each—the two stations defining each point, the elevations of the profile grade below and at "low steel" above, and the difference which is the underclearance.
- 4. <u>limitations</u>. Both roads must have straight horizontal alignment. The clearance points must fall within the limits of vertical curves above and below. For points falling outside the curve limits, use a second program run defining the vertical alignment condition governing these points and voiding appropriate parts of each program output. A straight grade must be defined as a vertical curve with tangents on the same grade and a length encompassing the eight points.

The superstructure is assumed to be built to the upper vertical curve. If the beams are straight (as chords of the curve), then the upper grade must be adjusted to parallel them.

A straight grade must be defined as having equal tangent grades and a length other than zero.

5. Running Time. Three minutes; thirty seconds.

SALINA WICHITA

Abstract of Users Project 214

Class 1

TITLE: PATENT SEARCHING PROGRAM

Originator: Patent Division, Textile Fibers Department

Address: E.I. du Pont de Nemours & Company, Incorporated

Wilmington 98. Delaware

Mode: Machine Language G-15D

Date Released: December 12, 1958

This program makes it possible to carry out on the Bendix G-15-D computer a search of the U.S. Patent Office ILAS file on the resin art. A dexcription of the information-coding used and of the logic of retrieval used has been published in the Patent Office Research and Development Report No. 13, "A System of Retrieval - Compounds, Compositions, Processes and Polymers", November 17, 1958

The logical problem involved may be stated as follows: Given a file consisting of document (patent) numbers and subjects included within these documents, and a question consisting of one or more subjects of interest to the searcher, find in the file all document numbers pertinent to the question. Relationships between subjects are also encoded in the file, and may be included or ignored in the question. A system of "weighting" of subjects in the question allows the program to produce not only a list of documents completely answering the question, but also to list the documents which nearly answer the question, with an indication of the shortcomings of each.

This program includes routines for preparing the file on magnetic tape and for searching this file and typing out the results.

Accessories required are one MTA-2 magnitude tape unit and one small-diameter (1/2-inch) capstan-type paper tape drive for the G-15-D photoreader.

ABSTRACT

INTERCOM 101 APPLICATIONS SECTION Users' Project No. 215 Class 2

WATER DISTRIBUTION SYSTEM ANALYSIS

The program calculates the discharge, in gallons per minute, head loss in both feet and pounds per square inch, and the "k" constant in each pipe for a water distribution system. The Hardy Cross relaxation method, an iterative procedure, is the principle used for analysis of the problem.

Input values are pipe smoothness coefficient (constant for system unless pipe lengths are adjusted), maximum value of flow correction, and for each pipe in the system, the indicator value, assumed flow, length and diameter.

Assuming five sides per loop, a 35 loop system can be analyzed. This size system can be computed in about 1.7 hours excluding input time and assuming five cycles. The program is written in Intercom 101D. 140 locations are used for coding, constants and intermediate storage.

Maximum input is 724 pieces of data.

MIDWEST COMPUTER SERVICE, INC. Decatur, Illinois

Title: CONTINUOUS BEAMS WITH INTERMEDIATE HINGES

Class

Mode Intercom 1000 SP

Originator Tudor Engineering Company

Date November 1958

Given the span lengths, moments of inertia, and locations of any intermediate hinges for a series of continuous beams, the program will compute complete influence ordinates for uniform and concentrated loads. The maximum number of spans is limited to ten, and allowance has been made for cantilever spans at either end. The program will also compute dead load values for uniform load on the spans and concentrated loads at the ends of the cantilever spans.

The span lengths and location of the hinges may be variable, but the members must be prismatic. The values computed for each loading condition are as follows:

- (1) Moments at the joints and at some point (p) in each span. The latter may be varied for each span.
- (2) Shears at each side of the joints and total reaction at the joint.

The loading conditions computed are as follows:

- (1) Unit uniform load in each span, including the cantilevers.
- (2) Concentrated loads in each span. The location of these loads are variable. However, the program tape is set to every tenth point. Cantilever spans are loaded at the end with a concentrated load.
- (3) Dead load values for uniform loads on each span and concentrated load at the ends of the cantilevers. Two cases of dead loads are allowed for, and while the uniform load must be constant within any one span, it may be varied from span to span.

Moment distribution is used to calculate the joint moments. The moments in the span, the shears, and the reactions are computed by an application of statics.

The time required to enter input data varies with the number of spans. Provisions have been made to reduce input time if constant moment of inertia or constant uniform dead loads are desired. The running time also varies with the number of spans. Provision has been made to minimize the running time by typing out only those joints which are affected by a load. Moments, shears, and reactions not typed out have a value of zero.

A three span analysis requires about one hour.

Title:

DESIGN OF PILE FOOTING STUB ABUTIENT

Class:
Modo:
Originator:
Date:

Intercom 1000 Single Precision

Edwards and Kelcey, Engineers and Consultants
November 1958

Given the stem dimensions, footing thickness, allowable pile capacity and shear and various loading conditions, this program computes the required stem steel at the top of footing and, if desired, the backwall steel and required steel at one cutoff noint. The program also computes the final footing dimensions (toe, heel and overall width), the transverse and longitudinal pile spacing as well as the front row pile batter, the toe steel (if any is required), the heel steel, the volume of concrete and, for five loading groups, $\bar{\mathbf{x}}$ (the distance of the resultant of forces from the toe), the pile loads for the front and back rows and the horizontal shear per pile. The Standard Specifications for Highway Bridges, A.A.S.H.O. 1957, were used.

width and heel dimensions and increments either the toe or heel or both until either all the allowable conditions are satisfied or the maximum limiting overall width is reached. If the allowables have been satisfied, the longitudinal pile spacing is incremented until a failing value is computed. The longitudinal pile spacing is then decremented once and all final values are typed out. Each increment is equal to six inches and no transverse dimensions are decremented. Computation then proceeds to the footing steel. If the front row of piles is not under the stem, the toe steel is computed. If the front row of piles is under the stem, were is typed as the required area of toe steel. The heel steel and volume of concrete are then computed and computation halts. If the maximum limiting footing width had been reached, all quantities computed to that point would have been typed out, zero would then be typed as the volume of concrete and computation halts. To provision has been made for incrementing or decrementing the footing thickness. The effect of any fill over the too is neglected. This program is only valid for a stub abutaent on two rous of piles.

Input data consists of the equivalent fluid pressure, height of equivalent uniform surcharge, height of backfill, height of steel cutoff above top of footing, backgall steel wanted, stem dimensions, reactions from superstructure, maximum limiting footing width, allowable pile capacity and shear, ratio of pile spacing in heel divided by pile spacing in toe (decimal), "d" distance for heel steel if other than used in program and project number. The constants are the unit weights of fill and concrete, minimum and maximum pile batter, minimum and maximum longitudinal pile spacing, minimum width of heel, minimum width of footing, cover for stem and heel steel, distance from top of pile to L of toe steel, pile projection into footing, distance from L of pile to edge of footing and fs, j and u for reinforced concrete design. The designer may change any of these constants if necessary. The values of these items are shown on the input sheet.

The program write-up contains both a sample input and output sheet. The type-out is in the following order: Required stem steel area and perimeter (backwall, cutoff and main stem steel), the limits of \bar{x} (1/3W and 2/3W), \bar{x} for five loading groups, the footing dimensions (toe, heel and overall width), the front row batter, the pile spacing (transverse, front row and back row), the loads per pile for the five loading groups (front row, back row and horizontal shear), toe steel area and perimeter, heel steel area and perimeter and volume of concrete. The batter for each of the five loading groups is typed out should it exceed the maximum allowable batter.

Data input requires up to 5 minutes. Computation and typecut require from 10 to 20 minutes. No auxiliary equipment is used.

ABSTRACT

APPLICATIONS SECTION

Users; Project No. 218
Class 2

SOLUTION OF BOUNDARY SURVEY BY INTERSECTION

INTERCON 1000 (TAM 24A)

This program was written specifically to solve for areas, lengths of sides, and angles between sides, of a given small area of land where the courses are not well cleared for chaining, but the points on the perimeter are easily visible. The shape of the area need not be convex. Strict control of the method of surveying and of the party is necessary to control accuracy in the triangulation process.

Given the length of a baseline and the angles relative to it, from each end to a series of other points, the program computes the lengths between succeeding points, and the angles between the intersecting lines formed by connecting the points. It also computes the area enclosed.

The baseline can be inside or outside the boundary or it can cross the boundary but it cannot be taken as one of the sides of the boundary.

MIDWEST COMPUTER SERVICE, INC. Decatur, Illinois

Class

2

Title:

CONSTRUCTION TIE COMPUTATION

Originator: Address:

Richardson, Gordon and Associates 3 Gateway Center, Pittsburgh, Pa.

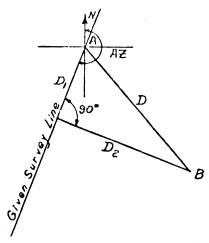
Mode:

Intercom 201

Date:

January 12, 1959

1. Definition. With given coordinates of A and B and the azimuth A_Z of the survey line which passes through Point A, the program will determine the bearing and distance of line AB and two construction ties D_1 and D_2 as shown.



- 2. <u>Input</u>. Azimuth of survey line and coordinates of points A and B. A maximum of 49 sets of values may be entered.
- 3. Cutput.

Azl

Az2

4. Computation Time. 45 seconds per set.

No auxiliary equipment is required.

Abstract of Users Project No. 220

Class

2

Title:

BUILT-UP BOX SECTION PROPERTIES

Originator: Address:

Richardson, Gordon and Associates 3 Gateway Center, Pittsburgh 22, Pa.

Mode:

Intercom 101

Date:

January 13, 1959

1. Definition. The program computes all of the required design properties of a box section used as a truss member. The basic box section may consist of either four angles with covers and web plates or two channels with covers only. The program can also vary the web thickness by 1/16 inch increments to provide a table of design properties for a basic section with fixed sizes of cover plates and angles but with varying web thickness. For new sizes of cover plates and angles or channels, new input data is necessary.

- 2. Input. The following information is necessary.
- a. In to in of gussets.
- b. b to b angles or channel depths.
- c. Area of angle or channel.
- d. Moment of inertia of angle or channel about its axes.
- e. Dimensions of web plates, cover plates, and angle o channel.
- f. Area, width, and spacing of manholes.
- g. Diameter and number of rivet holes in cover plates, web plates and angle or channel.

3. Output.

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	
Unit wt. based on full gross area lbs./ft.	Distortion area in. ²	Net area in. 2	Effective gross area in.2	y - C.G. measured from centerline of b.b. angles or centerline of channel. (+above, below)	I_{x-x} - in. ⁴ based on effective gross area	r _{x-x} - in. based on effective gross area	ly-y - in. 4 based on effective gross area	ry_y - in. based on effective gross area	

4. Limitations.

Angle section - maximum of 6 web plates and 6 cover plates. Channel section - maximum of 6 cover plates and no web plates. Both sections must be symmetrical about their y-y axis.

5. Computation Time. One minute per section. No auxiliary equipment is required.

PALMER & BAKER ENGINEERS, INC.

DESIGN COMPUTATIONS

MADE BY CharltonoATE 12-15-58

SUBJECT MATTER PROGRAM FOR BENDIX G. 15D COMPUTER CHECKED

CHECKED BY DATE

Abstract of Users Project No. 221

SHEET NO.

Title: Nose Location

Class:

2

Mode: Intercom 1000D

Originator: Palmer & Baker Engineers, Inc.

Date: December 15, 1958

This program locates the center (radius point) of a circular nose at the point where a ramp enters or leaves a roadway. The Intersection of two roadways (major fork) can also be handled. There are fourteen general types of roadway and ramp configurations included as well as roadway nose taper, ramp nose taper and roadway taper. In the case of a curved, narrowing taper, the nose curve is considered tangent to the tapering curve at the narrowest point, so no ramp nose taper information is necessary.

The values of all input items may be found on the terminal details standard drawings and/or on the plans. Input consists of one or two roadway stations; one or two ramp stations; radius or degree of ramp curve and roadway curve, if any; distance from each stationing line to the nose curve; distance between stationing lines; radius of nose and length and width of tapers involved...

Output consists of four numbers representing the station and offset from stationing line to center of nose curve for both the roadway and the ramp.

The problems are reduced to a series of triangles which are solved by use of various trigonimetric formulae and identities.

The flag which separates the value of curve radius from degree is the number 30 which is stored in location 17.08 and can be changed as desired.

The descriptions of "Roadway" and "Ramp" are interchangeable in this program and may refer to either road so long as proper indications are made on the Input-Output sheet. Length and width of taper are used to determine the angle such taper makes with its base line.

Stationing lines must be located in the relative positions shown by the Input Diagrams; stationing on lines running through or beyond the nose should be transferred to a base line located as shown by the Input Diagrams for correct results.

Subroutines used: square root; sin, cos and arc tan

Auxiliary equipment used: none

Computation time: one minute

TEXAS GAS TRANSMISSION CORPORATION



416 WEST THIRD STREET . OWENSBORD, KENTUCKY

Title: Engine Crank Angle and Piston Displacement

INTRODUCTION

INTERCOM 1000 SP

Piston travel in a reciprocating engine is a function of the crank angle and the connecting rod length. Formulas taken from Marks!

Mechanical Engineer's Handbook were used to compute crank angles and piston travel. The method used is applicable only if the center lines of the piston rod and crankshaft lie in the same plane and the connecting rod is not articulated.

The table prepared by this routine is useful for the testing of any reciprocating engine. The program tabulates piston travel as a function of the crankshaft rotation starting from "top dead center" or will tabulate crankshaft rotation as a function of piston travel, depending on where entry to the program is made.

The program is written in Intercom 1000 S.P., and no auxiliary equipment is needed.

Prepared by: M. N. Kelley

Texas Gas Transmission Corp.

Owensboro, Kentucky

Jos	No	

SHEET NO....

USERS PROJECT NO. 223

Program Abstract

Title: Spiraled Bridge Design Geometry

Mode: Intercom 1000 D.P.

Subroutines: On Program Tape

Class: 2

Description:

The program computes coordinates, stations and top of template elevations at points defined as the intersection of a pier line and a line concentric to the centerline of the alignment. Middle ordinates are computed on each concentric line, between adjacent pier lines.

The horizontal alignment is defined by the radius, length of spiral, and the station at the T.C. or C.T. The vertical alignment may include a curve. The roadway template is defined by five points. Superelevation may be taken upward or downward, and rotated about either of two points on the roadway template. Superelevation transition is considered.

Specifications:

22 words of input define the alignments, and 25 words of input may be used to define the pier and concentric lines, depending on the output required.

Type-out is fixed-point, and the format is slightly variable.

Computation and type-out time is approximately one minute per point, for points stationed on the spiral.

The program uses the "exact spiral formulae", and the arc definition of curve.

ENGINEER

DATE.

Title: Concentrio Ciroles Bridge Deck Elevations

Class:

Mode: Intercom 1000 (Tech. App. Memo. #24A)

Originator: Cook County Highway Department

Date: 3 December, 1958

This program extends and revises the Beam Grid Bridge Deck Elevations Program, which was based on the Illinois Division of Highways' Program for Bridge Deck Elevations, to find the elevations on the roadway surface for bridges on curves, either Arc or Chord Definition, at the points of intersection of a set of parallel lines, usually parallel to the centerlines of bearings, with a set of concentric circles parallel to the stationing line.

The curves can be given with either known radius or known degree of curve.

The data required is the distance from the stationing line to the curves, the number and spacing of the lines parallel to the piers, the location of this set of lines with respect to a control point, the angle between the desired "X" axis direction and the lines parallel to the piers, the station of a control point on the stationing line and the angle between the tangent at this point and the lines parallel to the piers, the gradients and the limits of the vertical curve, the elevation of a point on the tangent preceding the vertical curve and the station of the point, the amount of the circular crown and the slopes of the pavement beyond the crown, the amount of superelevation, the location of the beginning and the end of one transition, the radius of the curve or the degree of curve, and a code for arc or chord definition.

The output will consist of the station, the distance to the stationing line, the "X" and "Y" coordinates if desired, and the elevation of each point.

The program will handle up to 15 concentric circles and up to 15 groups of lines parallel to the piers, each group having no proatical limit as to number of lines in that group of equally spaced lines.

Abstract of Users Project No. 225

Class 2

Title: LEAST SQUARES ESTIMATES FOR NON-LINEAR MODELS

Originator: Nylon Research Laboratory, Textile Fibers

Department, E.I. du Pont de Nemours and

Company, Incorporated

Address: Experimental Station, Wilmington, Delaware

Mode: INTERCOM 103

Date: January 14, 1959

An iterative procedure for obtaining least squares estimates is described. The method can be applied to any model with less than 10 parameters if the model can be differentiated with respect to each of the parameters.

Given a set of data (x/y) represented by the model $y = \frac{b_1 + b_2 x}{b_3 + x}$, find the least squares estimates of the parameters b_1 , b_2 , and b_3 .

/ah

Class 2

Title:

NUMERICAL DIFFERENTIATION OF EXPERIMENTAL

DATA FOR VISCOSITY CALCULATIONS

Originator:

Nylon Research Laboratory, Textile Fibers Department, E.I. du Pont de Nemours and

Company, Incorporated

Address:

Experimental Station Wilmington, Delaware

Mode:

INTERCOM 103

Date:

January 14, 1959

Differentiate rheometer piston displacement data with respect to time and obtain the piston velocity, and thus the fluid throughput and viscosity, as a function of time.

The differentiation is based on the following procedure (procedure obtained from personal communication with R. L. Pigford, Chairman Department of Chemical Engineering, University of Delaware).

- a) A parabola is fitted to 5 consecutive data points by the least squares method. The data points must be at equal intervals along the axis of the independent variable.
- b) The derivative is calculated at the middle data point.
- c) An estimate of the error at a 99% confidence level is given.
- d) The procedure is repeated with the middle data point being shifted to the next point. derivative is not calculated for the first two and last two points in the data list.

The output provides the following:

- a) values of x (time, sec)
 b) Q (throughput, mil3/sec)
- c) estimate of error in Q at 99% confidence level
- d) viscosity, poise
- e) minimum viscosity, poise
- f) maximum viscosity, poise
- g) values of y (piston displacement, mils)

/ah

Title:

RANKING OF PREFERENCE SCORES FOR

9-TREATMENT BALANCED DESIGN

Originator:

Nylon Research Laboratory, Textile Fibers Department, E.I. du Pont de Nemours and

Company, Incorporated

Address:

Experimental Station, Wilmington, Delaware

Mode:

INTERCOM 103

Date:

January 14, 1959

This program was written to translate preference scores (in 5-paired comparisons of 9 treatments with each of 3 other treatments) into rankings representing true order of preference. It is based on a procedure of N. G. Kendall, wherein the preference matrix is squared and the row sums are ranked until two successive sets of ranks are identical. Here, we have used actual preference scores (0-5) instead of 0's, 1/2's and 1's, so the procedure of matrix squaring is modified. For a larger number of treatments, the program would have to be modified with different settings and rank numbers. For N comparisons between treatments, the reference number in Loc. 121 would be reset to the value N/2.

Given 9 experimental treatments, each measured for some property in comparison with its 8 neighboring items, such that there are five paired sets of consecutive measurements of any two items. In each set, the superior item is given one point and the other zero. When a tie occurs, each item gets 1/2 point. Total scores for all comparisons are arranged in a matrix, with blanks along the diagonal.

The true ranking of all items in the test is found by the method of Kendall outlined in Biometrics, $\frac{4}{9}$, 43-62 (1951).

/ah

Abstract of Users Project No. 228

Class 2

Title:

LINEAR REGRESSION AND TESTING OF SIGNIFICANCE

Originator:

Nylon Research Laboratory, Textile Fibers Department, E.I. du Pont de Nemours and

Company, Incorporated

Address:

Experimental Station, Wilmington, Delaware

Mode:

INTERCOM 101, INTERCOM 103

Date:

January 14, 1959

This program provides a simple method of fitting a straight line y = a + bx to a set of experimental data.

Fit a straight line, y = a + bx, to a number of sets of data (x, y), by the least squares method, assuming that the experimental errors of the x's are negligible compared to those of the y's.

Output should provide:

- a) best estimates of a and b and their standard errors
- b) all expressions for testing the significance of the regression

Title: POLYNOMIAL DATA TAPE PREPARATION FOR USERS'

PROJECT NO. 132

Originator: Pioneering Research, E.I. du Pont de

Nemours & Company, Incorporated

Address: Experimental Station, Wilmington, Delaware

Mode: INTERCOM 201 (DAISY)

Date: January 20, 1959

This program prepares a data tape for use with Users' Project No. 132, Multiple Regression Analysis, to fit a power series to a set of experimental points.

This routine is submitted to the Bendix Users' Organization for distribution to all participating members by the Pioneering Research Division, Textile Fibers Department, E.I. du Pont de Nemours and Company, Inc., Wilmington 98, Delaware. Inquiries and comments should be directed to John A. Roetling.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

EMS:ah

Title: VALUE AND DERIVATIVE OF A POLYNOMIAL

Originator: Pioneering Research, E.I. du Pont

de Nemours & Company, Incorporated

Address: Experimental Station, Wilmington, Delaware

Mode: INTERCOM 201 (DAISY)

Date: January 20, 1959

This routine makes use of coefficients of a power series to calculate H and dH/dI for values of I at intervals Δ I between any given maximum and minimum I.

This routine is submitted to the Bendix Users' Organization for distribution to all participating members by the Pioneering Research Division, Textile Fibers Department, E.I. du Pont de Nemours and Company, Inc., Wilmington 98, Delaware. Inquiries and comments should be directed to John A. Roetling.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

EMS:ah

Title: POLYNOMIAL DATA TAPE PREPARATION FOR USERS'

PROJECT NO. 132 (For Variables, logeH, logeI)

Originator: Pioneering Research, E.I. du Pont de Nemours

and Company, Incorporated

Address: Experimental Station, Wilmington, Delaware

Mode: INTERCOM 201 (DAISY)

Date: January 26, 1959

This program prepares a data tape for use with Users' Froject No. 132, Multiple Regression Analysis, to fit a power series to a set of experimental points. The experimental points, H and I, are converted to logeH and logeI.

This routine is submitted to the Bendix Users' Organization for distribution to all participating members by the Pioneering Research Division, Textile Fibers Department, E.I. du Pont de Nemours and Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to John A. Roetling.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

EMS:ah

Abstract	of	Users'	Project	No	232	
		,	Clas	3.8	2	

Title: VALUE AND DERIVATIVE OF A POLYNOMIAL (For Variables logeH, logeI)

Originator: Pioneering Research, E.I. du Pont

de Nemours & Company, Incorporated

Address: Experimental Station

Wilmington, Delaware

Mode: INTERCOM 201 (DAISY)

Date: January 26, 1959

This routine makes use of coefficients of a power series logH = f(logI) to calculate H, and dH/dI for values of I at intervals ΔI between I min. and I max.

This routine is submitted to the Bendix Users' Organization for distribution to all participating members of the Pioneering Research Division, Textile Fibers Department, E.I. du Pont de Nemours and Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to John A. Reetling.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

EMS: ah

STANLEY ENGINEERING COMPANY PROGRAM FOR BENDIX G-15 D COMPUTER STEAM GENERATING UNIT PERFORMANCE COMPUTATIONS

User 'Froject No.233 (submitted Jan. 1959)
S.E.C. Program No. M-001
Class 2
Mode: INTERCOM 1000s

PART I - ABSTRACT

- A. The purpose of this program is to make the computations necessary after a steam generating unit test has been run. The "Short Form--A.S.M.E. Test Report Data and Results of Boiler Test" 1953 is used for recording the data. This form consists of two pages. The data obtained at the time of the steam generating unit test is recorded on page "A" of this form, and this data is then reduced according to the formulae on pages "A" and "B." These calculations are rather lengthy and considerable time can be saved by using this program. Up to 100 test runs can be computed without reloading the program.
- B. The input consists of the following items according to their item number on the A.S.M.E. form. (These items are circled on the A.S.M.E. form, shown in the sample problems accompanying this program): 7-9, 13-15, percent combustible in refuse sample, 19*, 20*, 23-25, 28, 31, 32, 34-38, 62, 63* and pounds of Now-down per hour. Output consists of items 16-18, 21, 22, 26, 27 and 55-66.
 - * If items 19 and 20 are known then item 63 is computed; if item 19 and/or item 20 are/is unknown, then item 63 must be entered as an input item.
- C. The program is set up for input of data by tape prepared on a Flexowriter but may be modified to accept typewriter input. Modifications necessary are included in the Operating Instructions.
- D. This program occupies 6 lines in memory. Three lines are used for command storage, one line for constants and output data, one line for input data and one line for the Flexowriter Input Conversion Subroutine.
- E. The program functions as follows:

 After the program has been loaded, the data tape for one test run is read-in, converted and stored. Computation of results begins, and results for that test run are typed out. An index register is used to specify the number of test runs that are to be computed. After the results have been typed, the data from the next test run is read in and the process is repeated.
- F. Specifications.

Mode: Intercom 1000s.

Subroutines used: Flexowriter Input (Optional)

Index registers used: One

Computing time: One minute 45 seconds per set of data. (Tape prepared on Flexowriter).

Fjuirment: G-15D (Flexowriter Optional).

- G. Limitations:
 - (1) Computes items 58 and 59 only on the basis that item 9 is less than 575°F.
 - (2) Can not be used for gaseous fuels.

Abstract of Users Project No. 234

Class 2

Title:

HEX TO DECIMAL INTERGER CONVERSION

Prepared by:

R. H. Judson

Address:

The B.F. Goodrich Co., Akron 18, Ohio

Mode:

Machine Language (S.P.)

Dates

January 20, 1959

Program will take any 1 hexadecimal interger number up to 989680. and convert to decimal (up to and including 9, 999, 999.) Conversion for intergers is exact and takes less than 3 drum revolutions. In case output would be 108 or greater, XXXXXXX. is typed out. Conversion is accomplished by successive division for 8 word times of powers of 10 into the original number and successive remainders. Successive quotients and the final remainder are the decimal digits. The internal Princeton round-off is compensated for on each division.

This program permits the faster interger input routines to be used.

It also should enable certain accounting jobs to be programmed to work with intergers and thus avoid the rouding due to conversion of decimal intergers to binary fractions and back again.

The maximum decimal number which will be converted can be Z, 999, 999. 12 the overflow constant is changed.

This program will be distributed as a simple self contained program in line 00 with the hox number typed in, but is readily converted to sub-routine form.

Tatle: Beam Grid Bridge Dack Elevations

Class:

Mode: Intercom 1000 (Tech. App. Memo. #24A)

Cook County Highway Department 3 December, 1958 Originator:

Date:

This program is a revision and extension of the Illinois Division of Highways! Program for Bridge Deck Elevations - U.P. #134.

The problem is to compute the elevations on the roadway surface for bridges on either straight of curved alignment at the points of intersection of two sets of parallel lines. One set is usually parallel to the centerlines of bearings and the other set is normally the centerlines of the beams.

The curves can be defined by either Arc or Chord Definition of Curve and be given either with known radius or known degree of curve.

The data required is the spacing of the beams, their location with respect to a control point, the number and spacing of the lines parallel to the piers, the location of this set of lines with respect to the control point, the angle between the two sets of parallel lines, the station of a known control point on the stationing line and the angle between the tangent at this point and the direction of the piers, the gradients and limits of the vertical curve, the elevation of a point on the tangent preceding the vertical curve and the station of this point, the amount of circular crown and the slopes of the pavement beyond the crown, the amount of superelevation, the location of the beginning and the end of one transition, the radius of the curve or the degree of curve, and codes indicating straight or curved alignment and are or chord definition.

The output will consist of the station, the distance to the stationing line, the "X" and "Y" coordinates of curved alignments if desired, and the elevation of each point.

The program will handle up to 16 beem lines and up to 15 groups of lines parallel to the piers, each group having no practical limit as to number of lines in that group of equally spaced lines.

The program retains the original Illinois Program in such a way that it can be used with the original data as described in the original program if desired.

TITLE:

CURVE DATA FOR SPIRALLED CIRCULAR CURVES

CLASS:

2.

MODE:

INTERCOM 1000-D (T. M. 24A)

ORIGINATOR:

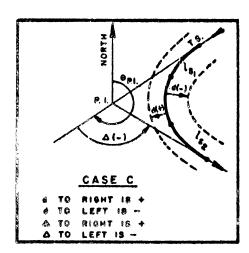
VOGT, IVERS, SEAMAN AND ASSOCIATES

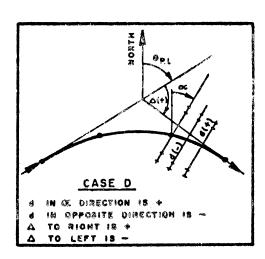
DATE:

December 10, 1958

In this program the curves include one circle and two spirals. The spirals may be unequal in length or one or both may be omitted entirely. The four main typeout options of the program are:

- A. Curve data which include: tangent distances, total length of curve, length of circular arc, radius of circular arc, "k" distance, "p" distance, and spiral angle for each spiral.
- B. Centerline stations and coordinates
- C. Coordinates of offset points for which the given distances are perpendicular to the centerline.
- D. Coordinates of offset points for which the given distances (from the centerline) are in a certain direction.





The input data vary with the typeout required. The input data consists of: deflection angle, spiral lengths, degree of circular curve, P. I. coordinates, azimuth of approaching tangent, distances to offset points and an increment of arc length. Intermediate points other than those determined by the increment may be given as stations, arc lengths from T. S., or arc lengths from S. T.

Limitation: Program will not work directly with a compound circular curve.

Abstract

Class 1

Euler's Gamma Function Subroutine For Intercom 1000S

Problem Description:

This machine language subroutine is prepared for use with Intercom 1000 single precision and it calculates the value of Gamma function $\Gamma(X)$ giving the argument X in the interval $0 \le X \le 2$.

Equation:

On P.157 of "Approximation for Digital Computors" by Cecil Hastings, Jr. the following approximation for Gamma function is given:

$$\int (1+x) = 1 + a_1 X + a_2 X^2 + a_3 X^3 + a_4 X^4 + a_5 X^5 + a_6 X^6 + a_7 X^7$$

where 0 < X < 1,

a₁ 0.57710166

a₅ - 0.56847290

ag 0.98585399

a6 - 0.25482049

a3 0.87642182

 $a_7 = 0.05149930$

a4 0.83282120

and the following relations are used:

$$\Gamma(X) = \frac{\Gamma(/+X)}{X}.$$

$$\lceil (1) - \lceil (2) = /.$$

Mitsubishi Mectric Tolyo, Japan

INTERCOM 103

Users' Project No. 238

Class 1

ABSTRACT

Calculation for Economical Operation of a Combined Thermal and Hydro Electric Power System

Problem Description:

This problem, essentially, is to determine the most economical distribution (or coordination) of generating power amongst a given number of plants during a day, for any load pattern, in a electrical power system which contains a steam plant and some hydro plants.

Economical usage of the water storage in the hydro plants is an important consideration, bisides the fuel cost in the steam plant and the loss of power in transmission.

"Gradient Method" is used in this computation.

Mitsubishi Electric Tokyo, Japan



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

Bendix Computer G-15-D Program Library No. APX 100060x (13) Page

Line CH/19 Name Index Register Manipulations; Intercom 1000 Double

> Abstract of Users' Project No. 239 Class '

Title:

INDEX REGISTER MANIPULATIONS

Originator: Pioneering Research Address:

Experimental Station

E. I. du Pont de Nemours & Co., Inc.

Wilmington, Delaware

Mode:

Appendix Subroutine 100060x (13) for

Intercom 1000 Double Precision

Date:

January 23, 1959

This subroutine allows the user to exchange index register contents, to negate the D register for decrementing, and to reset the D register to its original positive value. Pairs of intercom orders are needed for each operation, as in the Mag Tape Appendix. Contents of the Accumulator are undisturbed. This subroutine may be stored in any line, 09 through 18, inclusive. It will work only in the automatic mode since it is executed from line 19. Locations 00 through 43, inclusive, and 49, 50, and 51 are unused and may be used for program, constants, or intermediate results.

Users' Project No. 240

ABSTRACT
of
Circular Bridge Geometric Program
Intercom 103D

Michigan State Highway Department (For Class I Distribution)

Knowing a base radius, concentric radii, a tangent baseline for intersecting roadway having a skew angle and offsets parallel to this tangent; find intersection of curve and two tangents and slope of chord. Knowing beam location parallel to chord, find intersection of beam lines with tangent lines, crown, superelevation, and vertical curve elevations.

Program may be used for multiple spans, multiple bridges having a common vertical curve, superelevation in transition and parabolic crown. Effect of crown and superelevation may be limited transeversely.

Users' Project No. 2111

ABSTRACT of

Beam and Circular Screed Program

Intercom 103D

Michigan State Highway Department (For Class I Distribution)

Knowing a base radius, concentric radii, a tangent baseline for intersecting roadway having a skew angle and offsets parallel to this tangent, beam location parallel to chord, beam deflection and camber, and minimum thickness of slab; find elevations at each end at top of beam and top of slab so that the slab will have minimum thickness. If a screed with "n" points find top of screed elevations, distance from beam to screed parallel to bearing line and vertical difference from beam to screed for each point.

Program will accommodate one span at a time, with beam and screed combinations totaling 39. Bridge may have vertical curve, superelevation in transition and parabolic crown. Effect of crown and superelevation may be limited transversely.

Jos	No
-	110

Queer	No		

USERS PROJECT NO. 242

Program Abstract

Title: Spiraled Way-Alignment

Mode: Daisy 201

Subroutines: Daisy Appendix

Class: 2

Description:

The program accepts an alignment of up to seven (7) P.I.'s, defined by P.I. coordinates, with each curve defined by its radius and the length of leading and trailing transition spirals.

The program computes the tangent traverse and curve data for the alignment.

Information at detailed points on the alignment may be computed if desired.

Specifications:

The program uses the "exact spiral formulae", and the arc definition of curve.

Type-out is fixed-point, and the format is variable. Computation and type-out time is approximately two minutes per curve, and fifteen seconds per detail station.

ENGINEER
DATE

PROGRAM ABSTRACT

Frogram: Compound Curves (G-6)

Class: 2

Mode: INTERCOM 1000 D.P.

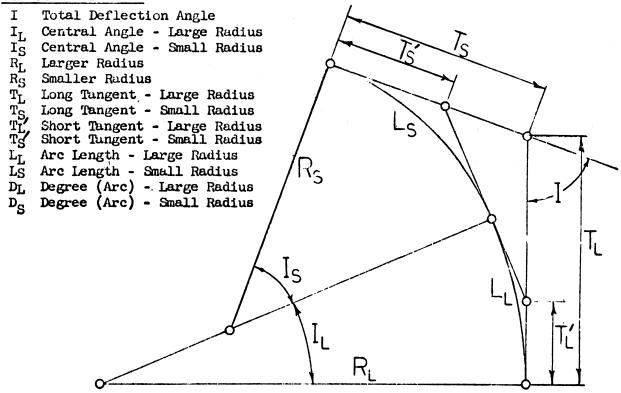
Originator: Parsons, Brinckerhoff, Hall & Macdonald

January 14, 1959

For a pair of compounded circular curves, this program produces the total deflection angle and for both curves, the central angle, radius, long and short tangent lengths, arc length, and the degree of curvature by arc definition. (See list below.) Sixteen cases are provided, permitting that many different combinations of known, starting data. (See box and diagram below.)

	INPUT ITEMS PERMITTED																
SYM	ITEM - CURVE ELEMENT				I	VI?	JT	Pl	ER.	C/	\SE	C					
Code I IL IS RL RS TL	Case Code Number Total Deflection Angle, D-M-S Central Angle-Larger Radius, D-M-S Central Angle-Smaller Radius, D-M-S Larger Radius - feet Smaller Radius - feet Long Tangent - Larger Radius Side Long Tangent - Smaller Radius Side	x	x	x x	x x	x x x	x x x	x	x	x x x	x x x	x	x	x x	x	x x	X X

OUTPUT - ALL CASES



J. STEPHEN WATKINS

CONSULTING ENGINEERS
446 EAST HIGH
LEXINGTON, KENTUCKY

ABSTRACT

Intercom 1000 D

Horizontal Alignment Package

- 1. Horizontal Curve (simple)
- 2. Spiral Curve (any degree)

This package consists of two separate programs, one for the solution of a simple curve and the other for a spiral curve.

Given the P.I. station, Degree of Curve and Δ Intersection angle, the program will solve for R, T, L, E and P.C., P.T. stations. Any number of curves may be given the program for consecutive computation.

Given the P.I. station, Degree of Curve and the Length of Spiral desired, the program will compute the following pertinent data for the spiral:

P.I.		K
Δ		x_c
$D_{\mathbf{c}}$		$\mathbf{Y}_{\mathbf{c}}^{\mathbf{c}}$
D _C A _C R _C L _C T _S		L.C. _s
$R_{\mathbf{c}}$		L.T.
$L_{\mathbf{c}}$		S.T.
$\mathbf{T}_{\mathbf{S}}^{-}$		T.S. station
_		S.C. station
E _s P	•	C.S. station
P		S.T. station

The B.P.R. symbols and definitions were used. The time for computation of a Horizontal Curve is 35 Sec. and 45 sec. for the spiral.

No auxiliary equipment is required.

ABSTRACT

Users' Project No. 245

Class 1

INPUT SYSTEM FOR FIXED PONT SINGLE PRECISION NUMBERS

This program has been designed to store fixed point single precision numbers (FX. SP.) into the specific memory locations of G-15D. It consists of,

- (1) Input as FX. SP., integers or fractions, whrough the type-writer.
- (2) Input as FK. SP., Integers or fractions, through the tape prepared by the off-line flexowriter.
- (3) Input as "indexed" FX. SP. integers through the tape prepared by the off-line flexouriter.
- (4) Transfer of upper triangular matrix elements to the locations of the lower triangular matrix. This routine can be utilized when simultaneous equations are solved or a matrix for a symmetric matrix by the program of R.T.R.I.

Remarks:

When much proportion of the input data through the tape prepared by the flexowriter are zero's. It is convenient if we have only to punch non-zero data with the index information which shows the locations of these non-zero data. Thus, the labour of flexowriting can be deminished considerably. The term "indexed" of (3) means this situation.

The wrong reading in of the tape and numerical errors of flexowriting can be detected by the collation of the decimal sum of the data in one line computed by nand with that of computed by the computer. This error checking method is involved in (2) and (3).

Sigemiti Suzuki RAILWAY TECHNICAL RESEARCH INSTITUTE Tokyo, Japan Users' Project No. 246

Class 1

SIMULTALEOUS EQUATIONS SOLVER

This program has been written to solve simultaneous linear equations of the order up to and including 41 by Gaussian elimination method. Machine language is used with fixed point single precision arithmetics.

The time estimation of solving n x n matrix is about 0.0012 n³ minutes, this is about one fourth compared with the routine written for Intercom 101.

On account of fixed point operations the matrix to be solved must be well conditioned.

Solutions are typed out. Residuals, $P_0 = AX - b$, can be evaluated and typed out if one wishes.

About forty simultaneous equations of the order up to 30 associated with the structural analysis and the other engineering field are solved successfully with the sufficient accuracy.

The problem is to solve the simultaneous linear equations (1).

$$a_{11}X_{1} + a_{12}X_{2} + \cdots + a_{1n}X_{n} = b_{1}$$

$$a_{21}X_{1} + a_{22}X_{2} + \cdots + a_{2n}X_{n} = b_{2}$$

$$a_{n1}X_{1} + a_{n2}X_{2} + \cdots + a_{nn}X_{n} = b_{n}$$

These equations are solved by Gassian elimination with back substitutions.

Eliminating processes are formulated as,

(2)
$$a_{ik} = a_{ik} - \frac{\epsilon_{ir}}{a_{rr}} (r)$$
 (r) $(r+1)(r) - a_{ir}^{(r)} b_{r}^{(r)}$, $(r+1)(r) - a_{ir}^{(r)} b_{r}^{(r)}$,

where $^{\mathbf{r}}$ is the iteration number of the elimination cycle and $\mathbf{r} \leq \mathbf{i}$, $\mathbf{k} = \mathbf{n}$. $\mathbf{a}_{ik}^{(1)}$ and $\mathbf{b}_{i}^{(1)}$ are set to \mathbf{a}_{ik} and \mathbf{b}_{i} . at the last of the elimination cycle the original equations are transformed to (3).

(3)
$$a_{11}X_{1} + a_{12}X_{2} + \cdots + a_{1n}X_{n} = b_{1}$$

$$(2) \qquad (2) \qquad (2)$$

$$a_{22}X_{2} + \cdots + a_{2n}X_{n} = b_{2}$$

$$\vdots \qquad (n) \qquad (n)$$

$$+ a_{nn}X_{n} = b_{n}$$

From these equations back substitutions are executed as (4).

(4)
$$X_{i} = \begin{bmatrix} b_{i}^{(i)} - a_{i,n-1}^{(i)} + a_{i,n-1}^{(i)} + a_{i,i+1}^{(i)} & a_{i,i+1}^{(i)} \end{bmatrix}$$
(a)

Sigemiti Suzuki RATIWAY TECUMICAL RESEARCH INSTITUTE Tokyo, Japan

ABSTRACC

Users' Project No. 247

Class 1

TRANSPORTATION PROBLEM SOLVER

This program is designed to solve a problem of the transportation type, which is a special case of the general linear programming, by the revised simplex method originated by G. B. Dantzig and Wm. Ochard-Hayes.

Machine language is used taking a full advantage of a binary digital computer. Arithmetic operations are performed with fixed point single precision except for the total cost. An element of the inverse matrix of a basis is stored in 2 bits.

Problems whose size are a+b≤ 56 can be treated without any external storage. The time required to solve the problem will be estimated as follows,

1.6 ab sec for initial steps

0.4-0.5 ab sec for each iterative cycle,

where a and b are numbers of sources and destinations respectively.

A company operates a's plants producing a commodity the <u>i</u>th of which can supply S units. The company sells its production to b's customers the <u>j</u>th of which demands D units. The cost of manufacturing and the transportation of the commodity from plant <u>i</u> to customer <u>j</u> is C_{ij} . It is desired to find the number of units X_{ij} that should be shipped from each plant to each customer so that the total cost of the operation is minimum. Mathematically the problem may be stated as:

Minimize (1).

(1)
$$Z = X C_{ij} X_{ij}$$

under constraints (2) and

under constraints (2) and (3),

(2)
$$\sum_{j} x_{ij} = S_{i}$$
,

(3)
$$\sum_{j} X_{i,j} = D_{j},$$

where $1 \le i \le a$, $1 \le j \le b$. The problem may be visualized by the following tables:

Dest. (i) (j) Source	1	2	• • •	Ъ	s _i
1	$x_{11}(x_0)$	x ₁₂ (x ₁)	• • •	$x_{16}(x_{b-1})$	s ₁ (q ₀)
2	x ₂₁ (x _b)	40	• • •		s ₂ (q ₁)
•					•
a	X nl	X n2		X (X) r.n ab-1	
D j	D _l (q _a)	D ₂ (q _{a+1})		D ₆ (a _{a+bel})	

Number of units of transportation. Supplies and Demands

3	1	2	ь
1	c ₁₁ (c ₀)	c ₁₂ (c ₁)	C (C)
2	c ₂₁ (c _b)	C ₂₂ (C _{b+1})	C ₂ b
•			
a	C nl	C n2	C rın

Unit cost matrix

Quantities appeared in (1), (2) and (3) will be rewritten as quantities in the brackets of the table.

The detail solving method and some programming techniques will be found in my paper titled "Programming Techniques for Solving the Transportation Problem".

Sigemiti Suzuki RAILWAY TECHNICAL RESEARCH INSTITUTE Tokyo, Japan

ABSTRACT

Users' Project No. 248

Class 1

MATRIX INVERTER

This program has been written to invert a matrix of the order up to and including 32 by Gaussian Elimination Method. This is a companion work of Simultaneous Equations Solver of R.T.R.I.

Machine language is used with fixed point single precision arithmetics. The elements of the inverted matrix are typed out column by column with the nexadecimal column heading.

The time estimation of the inversion will be shown by following examples.

- 1) 26 x 26 115 minutes (including the time for type out)
- 2) 32 x 32 150 minutes.

On account of fixed point operation the matrix to be inverted should not be ill conditioned.

The problem is to invert a matrix A. This is to solve the matrix equation (1).

(1)
$$AX = E$$

where E is the identity matrix of the order n.

The method of solving is Gaussian elimination with back substitutions as in Simultaneous Equations Solver. Elimination Cycles are operated on a matrix (A,E,) at the last of which it is transformed to

A is transformed to the upper triangular matrix A' and $^{\rm E}$ is transformed to the lower triangular matrix E'. Then the (1) is transformed to (2).

- $(2) \quad A'X = E'$
- (2) is solved by back substitutions. The elements of X, A^{-1} , are evaluated and typed out column by column.

Sigemiti Suzuki RAILWAY TECHNICAL RESEARCH INSTITUTE Tokyo, Japan Abstract of Users Project No. 249
Class 1

Title:

DECODER

Prepared by:

R. H. Judson

Address:

The B.F. Goodrich Co., Akron 18, Ohio

Mode: Date: Machine Language January 20, 1959

This program is an aid to decoding a basic machine language program already on tape. Blocks of tape are read in and all non-zero word locations and their contents in both hex and decimal command form are typed out in numerical sequence.

Optionally, the hex form may be omitted. There are no halts for next command from AR or for transfer of command line.

Timing:

Limited only by typewriter speed.

Abstract of Users Project No. 250

Class 1

Title:

MATRIX SHRINKER (For Matrix Algebra Problem, App. Project #43)

Prepared by:

Address:

R. H. Judson

The B.F. Goodrich Co., Akron 18, Ohio

Mcdet Date Intercom 1000D January 20, 1959

This program will read a square or rectangular matrix input tape prepared by or for Matrix Algebra Program, delete any designated row and column of data and punch cut a new tape in the proper format but of less order for the MAP program. Additional column vectors are automatically handled.

This program was written especially to delete rows and columns from a $\angle X_1X_2$ or r_{1j} matrix developed by a multiple regression program which depends upon MAP for matrix inversion and multiplication, but will handle any MAP data tape.

Timing:

About 50 % longer than tape punching time.

 7×8 to 6×7 ; $2\frac{1}{2}$ minutes.

Abstract of Users Project No. 251
Class 1

Title:

INTERCOM COMMAND LISTER

Prepared by:

R. H. Judson

Address:

The B.F. Goodrich Co., Akron 18, Ohio

Mod a:

Machine Language (S.P.)

Date:

January 20, 1959

Program will read in punched paper tape containing Intercom commands and type out sequentially, locations of commands and non-zero commands in standard input form. No attempt is made to differentiate between data and commands, therefore, programs should preferrably locate data in lines not used for commands. On BP, program types 50 locations and stops so that columns of 50 commands can be typed on 11" paper.

Format:

CHWD Tab K space OP decimal ADDR carriage return.

Timing:

As fast as typewriter will go.

(Simpler but faster than Application Project No. 64)

USERS! PROJECT NO. 252

Class 2

ABSTRACT

Intercom 500 (1000S)

It is often desirable to use fixed point data input with Intercom 500 using another mode besides the typewriter input. This routine permits fixed point data on IBM cards, or prepared on an off-line Flexowriter to be read in under rather flexible conditions controlled by the program.

The subroutine handles fixed point numbers between 0.0001 (floating point representation 46.10000) to 99,999 (floating point representation 55.99999). Up to 14 words may be read in at any one time, converted and stored. Each word may be represented by 5 decimal digits or less.

Subroutine uses lines 17 and 18 and stores converted words in location 1881 . . . (1880 + i).

Previous to entering the "Apricot" subroutine, the immediately preceeding commands set the proper information for the number of digits and the decimal point for each word being read in.

Index register v and w may not be used.

THE CHEMSTRAND CORPORATION DECATUR, ALABAMA

TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

INTERCO	M 201 PR	OGRAM	NO	NCP-26	_	
TITLE	Non-Linea	r Estim	ation			

ABSTRACT OF USERS PROJECT NO. 253

CLASS 2

TITLE: Non-Linear Estimation

ORIGINATOR: Carothers Research Laboratory

Textile Fibers Department

E. I. du Pont de Nemours & Co., Inc.

ADDRESS: Wilmington 98, Delaware

MODE: Daisy 201

DATE: February 2, 1959

This program presents a trial and error method of fitting non-linear models to experimental data.

Input consists of a data tape containing values for X_0 , Y_0 , X_1 , Y_1 . . . X_n , Y_n , and initial values for the parameters.

The following are typed out at each iteration, r, the number of the iteration, φ (r) the sum of squares, V (r), φ (r)/n-k-1, S(r) - $V^{1/2}$ (r).



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

PROGRAM	NO.	NCP-32

TITLE Appendix #039 - Intercom 103-D/Daisy Tape Input

ABSTRACT OF USERS' PROJECT NO. 254

Class 2

TITLE: Daisy 201 Appendix #039

Intercom 103-D/Daisy Tape Input

ORIGINATOR: Carothers Research Laboratory

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98. Delaware

MODE: Daisy 201

DATE: February 2, 1959

Given punched paper tape prepared by either Intercom 103-D or the Daisy 201 interpretive system, this program stores the input as double precision floating point numbers.

Appendix 39 may be stored in any appendix line.

TITLE: Payroll

CLASS: 2

MODE: 1000D

ORIGINATOR: J. Stephen Watkins Consulting Engineers

DATE: January 20, 1959

This program was written to compute a payroll on a weekly or bi-weekly pasis and will handle any number of employees. It will compute all necessary information for making out an employee's check. The program works with two sets of date: A. Previously punched tape containing employee's number, hourly wage, O. T. wage, # of exemptions, insurance rate, FICA to date and a flag denoting whether city tax is to be taken out. B. Information taken directly from the employee's time sheet and typed into the machine; employee number, number of regular hours worked and number of overtime hours worked. The computer will type Employee's number, his hours worked, his hourly amount, and compute gross, fed. withholding, FICA, city tax, state tax, insurance deduction, advance pay deduction, other pay and net pay. When all employees are finished all columns will be totaled and a breakdown of divisions (indicated by employee #'s) will be totaled. Regular, O. T. and Gross will also be totaled for Field and Clerical workers.

Possible changes or deletion of each deduction computation are explained in the write up, making the program more versatile.

Type out is to 3 places and round off is left for the payroll department.

Operating time is a minute and a half per employee including type in of time sheet data and type out of answers.

No auxiliary equipment is used.

ABSTRACT

APPLICATIONS SECTION

Users' Project No. 256

Class 1

BRIDGE ROADWAY ELEVATIONS

This program will compute the elevations on the roadway of a skewed bridge on horizontal tangent and a vertical curve. There may be no more than 22 stations on the bridge and any number of stringers, only so long as there are no more than 13,500 points to be found. The bridge may be on a crest curve, sag curve or on tangent. The cross section of the roadway may be any shape formed by no more than 4 straight lines.

The program occupies locations 000 to 159 and the input data is located from 094 to 116 and 160 to u99.

Output is in fixed point. The total running time is 18 to 26 minutes per bridge. The program need not be re-read for the running of a second set of elevations.

MIDWEST COMPUTER SERVICE, INC. Decatur. Illinois

Abstract of Users Project No. 257 Class

Title: Plotter of x = f(y)

Originator: Wilson & Company, Engineers

Address: 631 East Crawford, Salina, Kansas

Mode: Intercom 1000 (S.P.) Tape provided Arranged for easy conversion to D.P.

Date: January 1959

Application: Given a program for x = f(y), where there is one value of x for each value of y, this program will plot the curve of the function using carriage returns for vertical scale of ${f y}$ and tab spaces as the scale of ${f x}_{f st}$

Input: 1780 minimum value of y Limits to be plotted 1782 maximum value of y 1783 x range (tabs desired)

The x range defines the horizontal scale of the graph. A range of 40 fits 11 inch paper.

The vertical range can be varied by septing for single, double or triple space carriage return.

Output: The maximum y value is typed followed by a tab space. One tab is executed to position paper. Tabs are then executed to place carriage for locating the appropriate value of x. x is then typed and the decimal point may be considered to be the plotted point. One carriage return is executed and the operation repeated until twenty-one values of x and y have been used. The values of y will be 21 values from y maximum through y minimum with constant difference between adjacent values.

- Operation: 1. Load Intercom 1000
 - 2. Load "Plotter"
 - 3. Load your program for x = f(y) avoiding lines 15, 16 and 17
 - 4. Type y limits and x range in 1780, 1782 and 1784
 - 5. Set all tabs
 - 6. Start computing at the beginning of your program

x = f(y): The first two instructions must set B_B to CHWD (Bw8 = WD, Bc8 = CH) and the third instruction is an unconditional transfer to location 1700. Program for f(y) must begin at location CHWD and end with an unconditional transfer to location 1716.

<u>Limitations</u>: y values will be evenly spaced. Random values are not applicable to this program. Inaccuracy of plotting may be as much as x maximum - x minimum, x range (tabs) or one tab space.

Abstract of Users Project No. 258

Class 2

Title:

CONDITIONED AIR QUANTITIES

Originator:

Consoer, Townsend & Associates

Address:

360 East Grand Avenue, Chicago 11, Illinois

Mades

Intercom 1000 Single Precision

Date:

February 18, 1959

This program processes the basic data for the computation of heat gain in a room. The input data consists of areas, temperature differences, infiltration length, ventilation volumes and coefficients. Computed and typed out is the sensible heat loss, the total of the sensible, latent and outside air heat loss, the sensible heat ratio, the apparatus due point and the dehumidified air quantity. Lata for up to eighteen rooms may be loaded at one time.

The computation and typeout time is about 45 seconds per room. At the completion of the program the program and data are intact so that it is possible to check for maximum coincident heat gain by changing only those items of data affected by the time of day, and rerunning the group.

Title

CANTILEVER RETAINING WALL DESIGN

Originator:

Alfred Senerch & Associates

Address:

10 South Wabash Avenue, Chicago 3, Illinois

Mode:

Intercom 101 or 103D

Date:

February 26, 1959

This program determines the spread footing dimensions required to meet designer specified toe pressure, center of pressure location, and factor of safety against sliding requirements. It provides all necessary steel and concrete data for the toe, heel and stem. The program automatically provides this data for a series of wall sections in which the height decreases by a specified amount.

The program is based upon a modified Users Project No. 28 that includes the correct calculation of soil pressures when the resultant lies forward of the kern, use of different soil factors at the toe than in the backfill, and the effect of toe overburden. If desired, the program can be limited to analysis.

The program ascertains whether the toe, the heel, or both (with the toe a specified proportion of the total width) is to be incremented in arriving at satisfactory toe pressures and then increments as necessary to a multiple of the specified design increment. It next provides the specified factor of safety by incrementing the heel only or by developing a shear key, whichever the designer specifies. The final width is developed by incrementing the toe only (if necessary) until the center of pressure is as specified. The program then proceeds with the steel data calculations of U. P. 28. The program next decrements the wall height and designs the next section, continuing to recycle until the footing for the specified minimum height wall is designed. Finally, it provides the detailed wall steel typeout of U. P. 28 for the highest wall.

The eight line typeout for each section includes the wall height; toe, heel and overall widths; toe and heel soil pressures and center of pressure location; factors of safety without and with passive toe pressure and required shear key depth; and the actual and minimum allowable depths to steel as well as the required steel are and perimeter for the toe, heel, and stem. When the final footing is wider than required by the toe pressure, the output also indicates the minimum width satisfying toe pressure requirements plus the corresponding factor of safety and/or the width also satisfying the factor of safety plus the corresponding center of pressure.

An error alarm sounds and the computer halts if a heel dimension exceeding a specified maximum is developed or if a negative toe or heel is developed; the negative dimension is also typed.

Input requires 6 minutes; time for the first wall section varies, each subsequent section is completed in less than 2-1/2 minutes when the backslope is 3%1 or less. Wall steel typeout requires 10 seconds per foot of height. The entire memory is used.

Abstract	of	Users	Project	Yo.	260
Class	8				

Title: CULVERT GEOMETRY

Originator: J. Stephen Watkins Consulting Engineers

Address: bus East High Street, Lexington, Ky.

Mode: Intercom 1000 (Double Precision)

Date: February 9, 1959

Given a culvert whose crossing station is on either a horizontal curve or a normal tangent section, this program computes the length from a baseline and the readway template elevation at up to 20 points along the culvert. The culvert may be partly or entirely on a vertical curve, or entirely on a vertical tangent.

When the crossing station is on a normal tangent, all points must be on the tangent. With the crossing station on a horizontal curve, one or more points may be on a tangent transition (for such points, no elevation is calculated; however, the station at the point and the length to the point are computed). If spiral, rather than tangent, transition is involved, points on the horizontal curve will be computed correctly, but any point not on the horizontal curve will be treated as if it were on a tangent transition.

Input for the curve program consists of: the radial distance from the base line to the curve on which each point falls; the difference in elevation between the crossing station elevation and each curve (elevations taken at a section of full superelevation); the crossing engle and station of the culvert; vertical curve data; radius to the base line; and the stations at which full superelevation begins and ends. Input for the tangent program includes all of the above except the horizontal curve items.

The output format for each point on a horizontal curve or on a normal tangent section gives point; number, length of culvert from baseline to point, and elevation at the point. Output for points on tangent transition includes point number, station at the point, length of culvert from baseline to P.C. or P.T. station, and length from baseline to point.

Data input requires about 5 minutes for a maximum of 20 points. Computation and typeout requires 20 against per point for horizontal curve or transition points, and about 10 seconds for paints on normal tangent. No auxiliary equipment is used.

DE LEUW, CATHER & COMPANY

ENGINEERS

150 NORTH WACKER DRIVE

CHICAGO 6

FI NANCIAL B-0424

Users' Project No. 261

ABSTRACT

TITLE:

Pier Analysis

CLASS:

MODE:

Intercom 1000 Single (500)

ORIGINATOR:

De Leuw, Cather & Company

DATE:

January 23, 1959

PROBLEM STATEMENT: The program computes the joint moments due to the following:

- (1) Unit horizontal load.
- (2) Uniform D.L. of pier caps.
- (3) Unit cantilever moment at left end. (4) Unit cantilever moment at right end.
- (5) Unit vertical concentrated load in each bay. (3 maximum per bay)
- (6) Temperature rise of 100° F. At the end, the total moments at each joint due to a norizontal load, uniform D.L., left and right cantilever moments, vertical concentrated loads, and temperature rise of D° F are typed out.

INPUT DATA:

- (1) Horizontal load at top of left column. Left and right cantilever moments. Temperature rise or drop.
- (2) Column Data.
- (3) Pier cap data.
- (4) Vertical concentrated loads and positions.

CUTPUT DATA: Joint moments of each member in ft-kips.

METHOD:

Modified Moment Distribution. Refer to paper titled, "Modified Moment Distribution" by George Fan presented at Ninth Meeting of Bendix Computer Users' Committee of Civil Engineering application.

- LIMITATIONS: (1) Piers must have no more than 7 bays.
 - (2) Columns may be either rectangular or circular. Pier caps must be rectangular. All members must be prismatic although each of them may have different dimensions.
 - (3) No account is taken of forces normal to the centerline of pier.
 - (4) For purposes of dead load, unit weight of the pier is taken as 150 lbs./cu.ft. Thermal coefficient of expansion is taken as .000006.
 - (5) Footings are considered as isolated.

ABSTRACT OF USER'S PROJECT NO. 262 CLASS 2

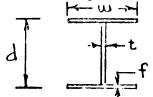
Title: Table Generator for Properties of Wide Flange Cross Section.

Mode: Machine Language - Single Precision Fixed Point.

Originator: Butler Manufacturing Company

Date: February, 1959

This program contains a collection of nine subroutines for computing the basic properties of a symmetrical wide flange cross section which can be defined by the following four basic dimensions:



The subroutines do not provide for fillets or for "built-up" sections made from a combination of plates and angles.

A suggested input data form is provided in the writeup and eight examples of sample input data and the resulting generated table are given. The four dimensions shown on the sketch above are variable input items and the input includes control numbers for the number of times each dimension is incremented. These control numbers also control the number of lines of type-out. The input also includes increments for each of the four dimensions, and is arranged so that each number may have up to five sets of increments and limits, the second increment replacing the first after the first limit is passed, etc.

A fixed point input routine is provided with slash key as decimal point and verification type-back is in fixed point. Data input is on typewriter only and requires about four minutes. Output averages seventeen seconds per line of type-out. The output format is shown below and is typed on a single line by the computer, but is shown here on two lines. The units are listed below each output item.

Area
$$I_x$$
 S_x r_x I_y S_y r_y d/bt h/t in. 2 in. 4 in. 3 in. in. 4 in. 3 in. in. -1 none

The writeup includes a separate set of specifications and coding sheets for the subroutines for each of the nine section properties listed in the output format.

RTS MM

ABSTRACT

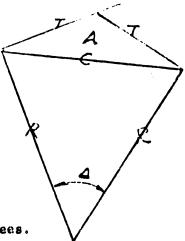
TITLE Simple Curve Problem (& R T C A)

CLASS 2

Given two elements of a simple curve, this program calculates the Delta, Radius, Tangent, Chord, and Arc and types them out in tabular form.

Formulae used are familiar to all engineers

Input is fixed point notation using Intercom 1000 double precision. A tag number showing which elements are given is entered followed by either Δ -R, Δ -T, Δ -C, Δ -A, R-T, R-C, R-A or T-C. Delta is entered as one word in degrees minutes and seconds and is converted to decimals of degrees.



Up to 50 sets of data can be entered at one time with the program sutomatically return ing to accept more data after calculation and typeout.

The mode of input is for the typewriter, but tape input can be used under the control of the operator. Input takes approximately 15 seconds per curve and typeout and calculation taking approximately 25 seconds per curve.

Sample Input: and Typeout

550900 s690900 s 1500 12/ s 52.1200000000000 1600 360600/ s 56.360600000000 1700 153/428 s 53.153428000000 1502 13/ s 52.130000000000 1602 360600/ s 56.360600000000 1702 50/ s 52.500000000000 1504 23/ s 52.230000000000 1604 153/428 s 53.153428000000 1704 50/ s 52.500000000000 34/ s 52.34000000000 1506 1606 50/ s 52.500000000000 1706 95/078 s 52.950780000000 .000000000000 1508

Tag	Delta	Radius	Tangent		Chord		Arc
12	360600.000 *	153.428 *	49.999		95.078		96.669
13	360600.000 *	153.428	50.000	*	95.078		96.669
23	360600.462	153.428	50.000	*	95.078		96.669
34	360608.727	153.417	50.000	*	95.078	*	96.669

1500 * Given data

EMMET J. MC DONALD & ASSOCIATES 55 E. CUYAHCGA FALLS AVENUE AKRON 10, OHIO Title: REAL AND COMPLEX ROOTS OF A POLYNOMIAL

Originator: National Research Council of Canada, Ottawa

Mode: Intercom 1000 SP

Date: 16 February 1959

Problem: Compute the roots of the polynomial $a_0 z^n + a_1 z^{n-1} + \dots + a_{n-1} z + a_n = 0$

Range: 2∠n ≤ 25 an ≠ 0

Abstract: The operator enters the polynomial's coefficients into memory locations 090h, 0905, ... Roots are typed out in fixed point. Two check mumbers are computed and also typed out. These correspond essentially to the sum and product of the roots and it correct are equal to all and an.

The method word is Hilne's quadratic factoring method, and will fail if two or more pairs of roots are equal or nearly equal.

Storage locations used: 0700 to 1029. Standard Intercome square root routine is in channel 9 and can be used by other programs.

Execution time: Depends on n and the number of Aberations required to converge on the roots. If at = 1, 2, 3, ... n, (n+1) the times for n = 5, 10 and 19 are 8 mins., 17 mins., and 1 hr., 38 mins., exclusive of input.

ABSTRACT OF USER'S PROJECT No. 264-A

Title: Real and Complex Roots of a Polynomial

Equipment Affected: Bendix G-15D, Intercom 500X

Class: 1

Originator: Queen's University Computing Centre

Date: August 17th 1960

This program computes the real and complex roots of polynomials using Milne's method of quadratic factoring. The range of application is $2 \le n \le 25$ where the polynomial is expressed in the form:

$$a_0 z^n + a_1 z^{n-1} + \dots a_{n-1} z + a_n = 0$$

Roots are typed out in fixed point notation and two check numbers are given which correspond to the sum and product of the roots and if correct are equal to a_1 and a_n .

This program uses the same approach as User's Projects Nos. 5 and 264, much of it being a transcription from the latter into Intercom 500X. Thanks are due to J.W. Wildrick of Bendix Products Division and Dr. D.C. Baxter of N.R.C. of Canada for those programs.

ABSTRACT

Basic Orifice Factor Program

Class 2

This routine calculates the basic prifice factor " F_b " for both pipe taps and flange taps according to the equation:

$$F_b = 338.17 d^2 K_o$$

This is equation #25 on page 83 of the American Gas Association publication, "Orifice Metering of Natural Gas," Gas Measurement Committee Report No. 3.

The program calculates "Fb" using the procedure outlined on pages 82 and 83 of Report #3 mentioned above. Input data for the program is the inside diameter of the meter run and the diameter of the orifice (dimensions in inches).

This program requires only the basic G-f5D, Daisy 201 or 202 and Daisy Subroutines #001 and 002.

Texas Gas Transmission Corp. Owensboro, Kentucky

STANLEY ENGINEERING COMPANY PROGRAM FOR BENDIX G-15 D COMPUTER COMBUSTION COMPUTATIONS PROGRAM

Users' Project No. 266 (submitted Feb. 1959)
S.E.C. Program No. 3-038
Class 2
Mode: Intercom 1000s

PART I - ABSTRACT

A. This program calculates the combustion air requirements for any fuel normally used in power generation work whether it be liquid, gaseous or solid. Products of combustion of any of the fuels mentioned above (including the effects of excess combustion air) and specific gravity and heating values of gaseous are also calculated.

All combustion air computations are based upon an air composition by weight of 23.15 percent oxygen and 76.85 percent nitrogen*, yielding a nitrogen to oxygen ratio of 3.3196. (* Argon and other rare inert gases are considered as nitrogen.) All constant values used in this program have been corrected to standard conditions of 60° F. and 29.92" Hg. to conform to the metering standards of the gas industry.

B. Input consists of the rercent by volume analysis for gaseous fuels, or the percent by weight analysis for liquid or solid fuels.

Output consists of combustion air requirements, products of combustion and the effects of excess air on the flue gas analysis for excess air from 0 to 100 percent (in increments of 10 % for all of the fuels mentioned above and, in addition, the specific gravity and heating values are calculated for gaseous fuels. (Heating values are calculated in terms of Btu/lb. and Divicu.ft.)

C. The program is set up for a single run and must then be reloaded for successive runs.

Typewriter input is used, as Clenowriter input was found to be impractical. No auxiliary equipment is necessary for this program.

D. The operating times are 14 minutes and 25 records for solid or liquid fuels, and 16 minutes and 40 seconds for pascous fuels.

Mode of operation: Intercom 1000-S.

E. This program is limited only by the number of constituents in the fuel being used. This program will handle twenty four common fuel constituents.

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BY DATE	CLICAT	BHEET NO
CHKD. BYDATE	SUDJECT	JOB NO
REF	Office Program Abstract	REF

CIRCULAR ARCS AND SEGMENTS Users Project No. 267

Program No. 127

This program computes the geometry of circular arcs, and the areas of circular segments. Nine cases of different input data are available,

Input:

The circular arc may be defined by nine combinations of the properties of the arc, as shown on the data form.

The properties of the arc are as follows:

N1 & El - Coordinates at the TC.

N2 & E2 - Coordinates at the CT:

Ø - North azimuth of the tangent to the curve at the TC.

R - Radius

S - Length of the arc

L - Chord length

 Δ - Angle of the curve.

Angles are entered in degrees, minutes and seconds; where the digits preceeding the decimal point are degrees, the second and third degits after the decimal are minutes, and the remaining digits after one zero are seconds and decimal seconds, thus:

For cases 3, 4, 5, 6, and 8 an indication must be made for a curve deflecting to the right or to the left. This is indicated by the sign of the values of of "R", or "A" as shown on the data form, where a positive sign (f) indicates deflection to the right.

Output:

The first and last lines of typeout are the "Job & Ref No.", and the the Program No. (127).

For each solution four lines will be typed. The first two lines are a typeout of the input data. For each case the remaining two lines are as follows:

		_		
1	-	L	S	
		Δ	A	Ac
2	-	L	R	
		Δ	A	Λc
3	-	1.	N2	E2
		Δ	A	Ac
4	-	L	N2	E2
		R	A	Λc
5	-	L	N2	E2
		S	Α	Λc
6	•	S	N2	E2
		Δ	Λ	Λc
7	•	R	N2	E2
		Δ	٨	Ac
8	_	S	N2	E2
		R	Α	Λc
9	-	L	S	
		R	٨	Ac

Where the notation is the same as for input data, except that "A" and "Ac" are the areas of the segment in square feet and acres.

ABSTRACT

APPLICATIONS SECTION

Users' Project No. 268

Class 2

INTERCHANGE GEOMETRY, CASES I, II, III, IV, V

The program calculates horizontal geometry of highway interchange connections. The following five cases are included in the program:

Case I Outside connection with one circular curve.

Case II Loop with one circular curve.

Case III Outside connection with two circular curves.

Case IV Loop with two circular curves

Case V Loop with three circular curves.

In all cases, the tangents must be parallel to the centerline of the intersecting highways or other base lines used as reference lines. In all cases, the program allows for the inclusion of transition spirals at either or both ends of the connection. The outside connections, Cases I and III can be used as portions of more complex layouts. The program does not allow for tangent sections within the connection.

Midwest Computer Service, Inc.



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

INTERC	OM 105-D PROGRAM NO. NCP-29	
TITLE	TABLES OF CORRESPONDING DIA	AMETERS
	ABSTRACT OF USERS PROJECT NO	0. 269
	CLAS	2

TITLE: TABLES OF CORRESPONDING DIAMETERS (A AND MILLS) AND DENIERS AND OF BIREFRINGENCES AND DRAW RATIOS FOR

GIVEN DENSITY

ORIGINATOR:

Carothers Research Laboratory

Textile Fibers Department

E. I. du Pont de Nemours and Co., Inc.

ADDRESS: Wilmington 98, Delaware

MODE: Intercom 103-D

DATE: February 18, 1959

This program yields a table of corresponding diameters and deniers and/or also one of corresponding birefringences and spun draw ratios for circular filaments of a given density.

Imput data consist of the density and the first, last, and incremental values of diameter in microns, and the first, last, and incremental values of birefringence. If desired, only one of the tables can be computed.

Besides the density the type out lists these columns, diameter (microns), diameter (mils), denier, birefringence, spun draw ratio, and extent of nonlinearity in spun draw ratio, if any.

TITLE:

"Ascending 4-Word Merge"

ORIGINATOR:

Economic Studies Section Textile Fibers Department

E.I. du Pont de Nemours & Co., Inc.

ADDRESS:

Wilmington 98, Delaware

MODE:

Machine Language

DATE:

March 6, 1959

ABSTRACT

This routine is part of an on-the-drum sorting system using a module of 4 words. It merges two groups of four words, each of which is already arranged (e.g., by routine ES-1) in order of increasing value.

Given eight binary numbers, in two groups of four such that the numbers in each group are arranged in order of increasing value, merge the groups to produce one 8-word ordered array of values.

DISCLAIMER

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Economic Studies Section, Textile Fibers Department, E.I. du Pont de Nemours & Co., Inc., Wilmington 98, Delaware. Inquiries and comments should be directed to Mrs. Eva M. Starr.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computation when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

TITLE:

"Insert Shift Codes into Alphanumeric Item"

ORIGINATOR:

Economic Studies Section Textile Fibers Department

E.I. du Pont de Nemours & Co., Inc.

ADDRESS:

Wilmington 98, Delaware

MODE:

Machine Language

DATE:

March 6, 1959

ABSTRACT

Alphanumeric items which have been processed by the computer may have been stripped of all non-essential characters for efficient storage and/or handling. It is desirable to reinsert upper and lower case shift characters in the alphanumeric item to obtain a neat appearance for Flexowriter output.

Given an alphanumeric item of less than four computer words, insert upper and lower case characters such that all letters (except "L") will be upper case, and all numbers and minus sign will be lower case.

DISCLAIMER

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No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

TITLE:

"Ascending 4-Word Sort

ORIGINATOR:

Economic Studies Section
Textile Fibers Department

E.I. du Pont de Nemours & Co. Inc.

ADDRESS:

Wilmington 98. Delaware

MODE:

Machine Language

DATE:

March 6, 1959

ABSTRACT

On-the-drum sorting of values is most efficiently performed as a modular process. One of the basic modules of such sorting is the arrangement of four values in the order of increasing value. This program carries out such an arrangement.

Given four binary numbers, arrange them in order of increasing value.

DISCLAIMER

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No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

TITLE:

"Screen Alphanumeric Item"

ORIGINATOR:

Economic Studies Section Textile Fibers Department

E.I. du Pont de Nemours & Co., Inc.

ADDRESS:

Wilmington 98, Delaware

MODE:

Machine Language

DATE:

March 6, 1959

ABSTRACT

Flexowriter-prepared alphanumeric tapes will frequently contain non-essential characters whose inclusion in stored information may be wasteful in terms of the computer memory capacity, or which may introduce unnecessary logical complications in the subsequent handling of this information. For example, delete codes, shift codes, and the like, will frequently fall into one of these categories. This routine has been designed to delete from an alphanumeric item (1 - 14 characters) all characters but the letters a thru z, the numerals 0 thru 9, minus signs, period, and space.

Given an alphanumeric item of four computer words, containing 1 - 14 characters of 8 bits each, supplied by the AN-1 accessory, delete all characters other than the letters a thru z, the numerals 0 thru 9, minus sign, period, and space. Store the resulting item in the most significant portion of the four-word item.

DISCLAIMER

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Economic Studies Section, Textile Fibers Department, E.I. du Pont de Nemours & Co., Inc., Wilmington 98, Delaware. Inquiries and comments should be directed to Mrs. Eva M. Starr.

No responsibility is assumed by du Pont for any mistakes, errors or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

TITIE:

"Ascending 100-Mord Sort"

ORIGINATOR:

Toonomic Studies Section
Textile Fibers Department

E.I. du Pont de Nemcurs & Co., Inc.

ADDRESS:

Wilmington 98, Delaware

MODE:

Machine Language

DATE:

March 6, 1959

ABSTRACT

This routine arranges up to 100 single-precision numbers in order of increasing value. It uses the modular 4-word sort and merge operations of Programs ES-1 and ES-3.

Given up to 100 single precision numbers (either positive or negative) in memory line 10, words 08-u7, arrange them in order of increasing value in the same locations. The numbers to be sorted are stored in the lower-numbered locations of the block 10.08-u7, and the end of the sequence is detected by the presence of four words of zeros in any locations 00-03 mod 4, or by reaching 10.u7.

Each 4-word group is first picked up from line 10, sorted, and stored in line 09. Next, the ordered 4-word groups are merged, two at a time, to arrive at the four highest and the four lowest members of the final series. The length of the remaining unsorted series is then reduced by eight words and the merging process is repeated, until the eight or twelve words in the middle of the series have been properly sorted, whereupon the sorted sequence is complete, and control is transferred to the return command.

DISCLAIMER

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members of the Economic Studies Section, Textile Fibers Department, E.I. du Pont de Nemours & Co., Inc., Wilmington 98, Delaware. Inquiries and comments should be directed to Mrs. Eva M. Starr.

No responsibility is assumed by du Pont for any mistakes, errors, or misrepresentations which may occur during computations when using this program; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this program.

Title:

PERPENDICULAR OFFSETS FROM FASCIA GIRDERS

Class:

2

Mode:

Daisy (Intercom 201)

Originator:

Vogt, Ivers, Seaman & Associates

Date:

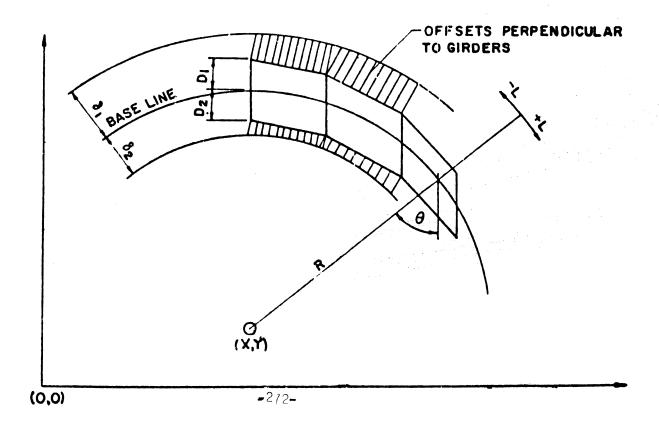
March 16, 1959

This program computes offsets from the fascia girder to a circular arc. Those offset distances are perpendicualr to each girder and are computed at the one-tenth points of the girder span. The circular arcs may be inside or outside of the fascia bearings and inside or outside of the base line arc.

The input data is as follows:

- a.) Coordinates of the center of the circle
- b.) Radius of the base line circle
- c.) Skew angle of the piers and abutments
- d.) Radial distances from the base line to the offset arcs
- e.) Base line arc lengths between piers
- f.) Distances measured along the pier from the base line to the girder bearing (distances may be different at each pier or abutment)

Limitations: Piers and abutments must be parallel. A maximum of 23 bearing lines may be processed.



LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

Abstract of Users' Project No. 276

ABSTRACT

Title:

Prestressed Concrete Design

Classi

Node:

Intercom 101 D

Originator:

Lockwood, Kessler, & Bartlett, Inc.

Dates

February 24, 1959

The problem is to design posttensioned prestressed concrete beams for simple span, composite berm highway bridges. Given the final geometry of the bridge, the program developed obtains the prestressing steel area, its pattern and location at midspan, the prestressing force required at the jacks and other data necessary for the design of both the interior and exterior beams. The appropriate sections of AASHO, BPR & ASCE-ACI specifications which govern this type of construction are followed throughout the progrem.

The progrem consists of a main program and auxiliary tapes. The main progrem computes all external loads and resulting stresses acting on the beam and then using the data obtained from the auxiliary tape, it computes the magnitude and location of the prestressing steel. In addition to this information, output also includes the prestressing force required at the jacks for the various tendons, the flexural stresses acting on the beam, the available and required ultimate moments, the required web reinforcement and the deflections necessary for camber calculations. A halt is provided after the design of both the interior and exterior beam so that various items of output may be inspected for conformity to the governing specifications. This allows for a new design of the beam using a greater prestressing force if deemed. necessary.

The range of prestressing steel patterns associated with each beem for any given prestressing system are listed on the individual auxiliary tames. The engine of a required to position the pattern selected by the program so that its centroid is st the computed distance from the centroid of the beam thus giving zero stress on the bottom fiber of the beam.

The program designs any of the four AASHO-PCI or eleven RPR standard beams. however their use imposes no limitations or restrictions on this program. The program is designed to accept other beams with a minimum of modifications. Similarly, the program is easily converted to the design of protensioned members.

The input consists generally of the areas of the selected interior and exterior beams, the general geometry of the span and bridge cross section, the flexural strengths of the materials used and the cable friction and curvature coefficients. The span length, stringer spacing, slab thickness, sidewalk dimensions and diaphregm data are included in the geometry input. The concrete and steel properties are altered if desired by additional input data.

Data input requires a maximum of about ten minutes and computing time is one to two minutes. No auxiliary equipment is necessary.



CONTINENTAL OIL COMPANY

P. O. DRAWER 1267
PONCA CITY, OKLAHOMA

March 16, 1959

Users' Project No. 277

MODIFICATION TO THE MAP¹ MULTIPLICATION AND INTERPRETER ROUTINES

ABSTRACT

The multiplication and interpreter routines of the Matrix Algebra Program have been modified by the insertion of a decimal to binary conversion routine and a counter. The purpose of this is to enable these routines to process any number of blocks of data without the need of manual intervention.

In the original MAP routines, it is necessary to type (tab s) for each block of data to be read, with an intervening wait between type-ins to allow for processing and output of data. With the modified routines a decimal type-in of (DD tab s) indicates that DD blocks of data are to be processed. This operation may be repeated any number of times.

LMatrix Algebra Program, Berman, Ray R., Bendix Computer Division, Applications Section, Project No. 43, 7 July 1958.



CONTINENTAL OIL COMPANY

P. O. DRAWER 1287
PONCA CITY, OKLAHOMA

March 16, 1959 Users' Project No. 278

MAP TO MAGNETIC TAPE

ABSTRACT

The purpose of this program is to write the Matrix Algebra Program onto magnetic tape, for use with the Magnetic Tape Service Routine. The only input necessary other than the program tape is a type-in of the MTA unit number on which the recording is to be done.

After MAP has been written onto magnetic tape, the Master Control may be read into its proper location by use of the Read instruction of the MTSR. MAP may then be operated as per the instruction manual, with the routines now being read from magnetic tape instead of paper tape. Magnetic tape commands within the MAP routine will be written with the MTA unit number used to load the routine onto magnetic tape.

Matrix Algebra Program, Berman, Ray R., Bendix Computer Division, Applications Section, Project No. 43, 7 July 1958.

Magnetic Tape Service Routine, Trumbo and Gill, Bendix Computer Division, Applications Section, Project No. 61.

Abstract of Users Project No. 279

Class ___2

Title: DESIGN OF VERTICAL CYLINDRICAL TANKS

Originator: Design Division, Engineering Department E. I. du Pont de Nemours & Co., Inc.

Louviers Building, Wilmington, Delaware

Mode: Intercom 1000

Date: February 18, 1959

Given the dimensions and loading of a vertical cylindrical tank this program calculates ring tension, moment, and wall shear at various points in the tank wall.

Solutions are applicable to vessel walls which can be treated by infinite beam equations (see S. Timoshenko, "Theory of Plates and Shells", Chapter XI, McGraw-Hill Book Company, Inc.). These equations are calculated for the full height of the wall but are most valid near the bottom. A long vessel (one in which infinite beam equations are valid) may be analyzed from both ends toward the middle if necessary. Loading may be uniform or hydrostatic, pressure or vacuum. Suggested application might include soil pressure for underground tanks, prestress loadings for prestressed concrete tanks, process pressure vessel design, vapor pressure or vacuum, etc.

The routine calculates the indicated values (ring tension, moment, and shear) at the top and bottom of the wall and at a number of equally spaced intermediate points. As written, the total number of points is ll but this can be varied at will by changing one program constant. After completing this set of calculations the wall thickness is automatically increased by a specified amount and the calculations repeated. This continues until the wall thickness exceeds a specified limit.

Input data consists of a key to indicate whether fixed base or hinged base calculations are desired, Young's modulus, Poisson's ratio, tank height and diameter, initial wall thickness, thickness increment and limit, uniform load, and density of liquid for hydrostatic load.

Output consists of the wall thickness followed by four columns of data as follows:

Column 1) height above tank bottom in feet

Column 2) ring tension in lbs./ft.

Column 3) vertical moment in ft.lbs./ft.

Column 4) shear in lbs./ft.

Data input requires about 3 minutes and calculations and output require about 4 minutes per wall thickness.

Users' Project No. 280

ABSTRACT

PRELIMINARY EARTHWORK

INTRODUCTION

This program is written to increase the speed and accuracy of preliminary studies of various highway alignments in respect to earthwork involved.

The program assumes a level template and a computed sloping ground with the selection of two side slopes, the areas are computed and volumes extended. Station, volume of fill, volume of cut and mass ordinate are typed out.

J. Stephen Watkins Consulting Engineers Lexington, Kentucky



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

BENDIX G-15-D PROGRAM NO. NCP-33

TITLE Integration and Mean Normalization of Data

Abstract	of Users	Project	No.	281
		Cla	ass	2

TITLE: Integration and Mean Normalization of Data

ORIGINATOR: Carothers Research Laboratory
Textile Fibers Department

ADDRESS: E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

MODE:

Machine Language G-15D

DATE: March 10, 1959

This program is written to extract one set of data from a punched tape containing multiplexed data from 1-99 channels, and to perform an integration and arithmetic mean normalization on this set of data and to store these data on magnetic tape. Given m + 1 values (up to 1560) of a function y (t) defined at equidistant intervals Δ t (i.e., t = 0, Δ t, 2Δ t m Δ t) on decimal punched paper tape, standard format (\pm DDDDDDD Tab \pm DDDDDDD Tab \pm DDDDDDD Tab/), in one long sequence, with a final stop code at the end, compute x (t) = y (t) - y (t). Successive even-numbered words on the paper tape contain successive 3 digit decimal integers, y (t), scaled at 2^{-24} (displaced 1 digit from the least significant end of the word) and the page number scaled at 2^{-12} . Corresponding odd-numbered words contain the decimal values of t/Δ t = 1, 2, 3 (up to 5 decimal digits), scaled at 2^{-28} . The first two digits of the odd word also indicate the channel number of this data point.

The channel number of the desired data is typed in, the program then types out this channel number, finds blank space on MTA-2, the magnetic tape, assigns and types out a file number, and page number, reads the paper tape, extracts, converts and stores the y (t) values, counts and types out m ÷ 1, computes and types the sum and average, computes x (t) and stores these data on Mag tape.



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

BENDIX G-15-D PROGRAM NO. NCP-34

TITLE Calculation of Autocorrelation Function

ABSTRACT OF USERS PROJECT NO. 282

CLASS ___2

TITLE: Calculation of Autocorrelation Function

ORIGINATOR: Carothers Research Laboratory Textile Fibers Department

ADDRESS: E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

MODE:

Machine Language G-15D

DATE: March 19, 1959

This program is written to compute the autocorrelation function

$$R(p) = \frac{1}{N-p} \sum_{n=1}^{N-p} X_{(n\Delta t)} \circ X_{(n\Delta t + p\Delta t)}$$

where N is the number of X (t) values stored on Magnetic Tape. The function R(p) is calculated at m + 1 points where p = 0, 1, 2, 3... m-1, m. Δt is the step-size on the t-axis. m is the largest shift.

The specified file number is typed in, converted to binary, and typed out. This file number is located on the Mag Tape. The data in the specified file are read into the memory in locations 18.u3 through 04.00 or into as many of these locations as are needed. The values of N, the number of data points, and m, the largest shift are typed in, converted to binary, and typed out.

For each p, a corresponding value of R(p) is calculated. A table is typed out

$$p_0$$
 $R(p_0)$
 p_1 $R(p_1)$
 \vdots \vdots $R(p_m)$

The R(p) values are also punched on tape in blocks of 104 words.



TEXTILE FIBERS DEPARTMENT WILMINGTON 98, DELAWARE

BENDIX G-15-D PROGRAM NO. NCP-35

TITLECalculation of Power Spectrum from Autocorrelation Function

ABSTRACT OF USERS PROJECT NO. 283

CLASS 2

TITLE: CALCULATION OF POWER SPECTRUM FROM AUTOCORRELATION FUNCTION

ORIGINATOR:

Carothers Research Laboratory

Textile Fibers Department

ADDRESS:

E. I. du Pont de Nemours & Co., Inc.

Wilmington 98, Delaware

MODE:

Machine Language G-15D

DATE: MARCH 25, 1959

This program is written to compute a power spectrum L(h) from the autocorrelation function R(p):

$$L(h) = \frac{1}{m} (R(0) + R(m) \cos 7r h) + \frac{2}{m} \sum_{p=1}^{m-1} R(p) \cos (\frac{ph 7r}{m})$$

The function L(h) is calculated at m + 1 points, where $h = 0, 1, 2, \dots, m-1, m$. h is the shift size, and m the largest shift.

The frequency conversion $f = \frac{h}{2m \triangle t}$ is calculated.

where f = frequency, cycles/second. Δ t, the time interval, is typed in, converted to binary and typed out. m, the largest shift, is typed in, converted to binary and typed out.

Punched paper tape, each block containing 104 values of R (p), is placed on the photo-reader. This tape may be prepared by NCP-34, Computation of an Autocorrelation Function. Memory lines 18 thru 05 are available for storing the R(p) values from paper tape.

The output is tabulated as follows:

Users' Project No. 284

PROGRAM NO. 94.501

CLASS 2

TITLE: Means and Standard Deviations of Grades

ORIGINATOR: Clarence B. Germain

ADDREGO: The University of Manitoba, Winnipeg 9, Manitoba

MODE: Machine Language DATE: February 2, 1959

PURPOSE: To compute the mean and standard deviation of a set of examination grades. As a by-product, the number of F's, C's, B's and A's are obtained.

DEFINITIONS:

x: a grade; specifically, an integer in the range $0 \le x \le 100$

n: the total number of grades

F: the total number of grades in the range $0 \le x < 50$

C: the total number of grades in the range $50 \le x < 67$ B: the total number of grades in the range $67 \le x < 80$ A: the total number of grades in the range $80 \le x \le 100$

x: the arithmetic mean of the grades

s: the standard deviation of the grades

METHOD:

F, C, B, and A are obtained by classifying each grade as it is entered and counting; n is obtained by the relation: n = F + C + B + A.

 \overline{X} is computed from the relation: $\overline{X} = \frac{\overline{L}X}{n}$.

 s^2 is computed from the formula: $s^2 = \frac{n\Sigma x^2 - (\Sigma x)^2}{n(n-1)}$.

s is then computed by $s = \sqrt{s^2}$.

Full accuracy has been maintained throughout the program. All outputs are rounded before type-out. All input and output is in decimal form.

INPUT: Each grade is typed followed by a tab or carriage return. Only the last three digits typed before the tab (or CR) are read by the program; thus an error, if noticed, may be corrected by typing the correct grade as a three digit number, preceeding it with zeros if necessary. A zero grade is entered by typing tab (or CR). If a grade is noticed to have been incorrectly entered after the tab has been hit, typing that grade with a minus sign will undo the effect of having typed it with a plus sign.

After the last grade has been typed, type s.

OUTPUT: All type-outs are from Line 19. Type-outs take the froms:

> I: CR CR

II: F tab C tab B tab A CR tab

III: n tab X tab s CR CR CR

F, C, B, A, and n are typed as four digit integers. X and s are typed in the form: DI).DDDD .

A breakpoint is included in the program after the last type-out.

E. I. DU PONT DE NEMOURS & COMPANY



BENGER LABORATORY WAYNESBORO, VIRGINIA

TEXTILE FIBERS DEPARTMENT

USERS PROJECT NO. 285

ABSTRACT:

CORRELATION COEFFICIENT

Given one or more sets of data, each set consisting of N values of each of n variates, with $3 \le N \le 3199$ and $2 \le n \le 40$; this program calculates and types out, in succession, the correlation coefficient matrix for each set. N and n may vary from set to set. An option is provided for typeout of input data.

Abstract of Users Project No. 286
Class 2

Title: NEW PRESSURE VESSEL DIMENSIONS

Originator: Pioneering Research Division

E. I. du Pont de Nemours and Co., Inc.

Address: Experimental Station

Wilmington, Delaware

Mode: Intercom 101-D April 8, 1959

Given the working pressure of a pressure vessel to be built as well as the usual size specifications, this program computes the required thicknesses of the various elements of the pressure vessel. It also finds and types out the nominal bolt size. The procedure followed is that described in ASME Boiler and Pressure Vessel Code, Section VIII, "Unfired Pressure Vessels".

Abstract of Users Project No. 287 Class 2

Title:

EXISTING PRESSURE VESSEL

Originator:

Pioneering Research Division

E. I. du Pont de Nemours and Co., Inc.

Address:

Experimental Station

Wilmington, Delaware

Mode: Date: Intercom 101-D April 8, 1959

From the known dimensions of an existing pressure vessel, this program computes its safe internal operating pressure and its required bolt size. The procedure used in the calculations is taken from ASME Boiler and Pressure Vessel Code, Section VIII, "Unfired Pressure Vessels".

Title:

DESIGN OF SPREAD FOOTING ABUTMENT

Class:

2

Mode:

Intercom 1000 Single Precision Edwards and Kelcey, Engineers and Consultants

Originator:
Date:

March 1959

Given the stem dimensions, footing thickness, reactions from deck, fill dimensions and various design codes, this program computes the required stem steel at the top of footing and, if desired, the required steel at up to two cutoff points as well as the required steel in the backwall. The stem steel may be computed for bending moment only or for both bending moment and direct axial load. The program also computes the transverse footing dimensions (toe, heel and overall width) and footing steel as well as, for six loading groups; \bar{x} (the distance of the resultant of forces from the toe), the toe and heel pressure and factors of safety against sliding and overturning. The last item computed is the volume of concrete. The Standard Specifications for Highway Bridges, A.A.S.H.O. 1957, were used.

The cutoff steel can be computed for either a specified height of cutoff or a ratio of required cutoff steel area to area of dowels in which case the height of cutoff will also be computed. The portion of the program which designs the footing begins with zero toe and heel dimensions (a value other than zero may be entered as input) and grows the footing until all allowables are satisfied or the maximum width is reached. Should an allowable value be exceeded and the maximum footing width has been reached, computation will halt after $\overline{\mathbf{x}}$, the soil pressures and factors of safety for all six loading groups as well as a flag showing which group failed and the transverse footing dimensions have been typed out. If the allowables are satisfied and the footing width is less or equal to its maximum value computation proceeds to the toe and heel steel and volume of concrete for the section. The program includes provisions for such conditions as bouyancy, passive pressure at the toe, fill over the toe and one horizontal concentrated load acting on the face of abutment. For the bouyancy condition, there can be no differential head between the front and back faces. The water level in front must equal the water level in back. The program will not change the input value of the footing thickness. This design is based on a one-foot section of abutment.

Input and constants consist, in general, of the same data a designer would require for a hand design. Constants may be changed if necessary. Output is in the following order: required stem steel (backwall, cutoffs and dowels) area and perimeter as well as height of cutoff for cutoff steel, the limits of $\overline{\mathbf{x}}$, $\overline{\mathbf{x}}$ for six loading groups, the transverse footing dimensions, toe and heel pressure and factors of safety against sliding and overturning for the six loading groups, required area and perimeter of toe and heel steel and the volume of concrete. The program write-up contains both a sample input and output sheet.

Data input requires up to 5 minutes. Computation and typeout require about 30 minutes, but varies considerably with the particular design. No auxiliary equipment is used.

stract of User's Project No. 289	stract	rojec	3	of U	stract
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Title:

PRELIMINARY CAPACITY ANALYSIS

Ab

Class:
Mode:

Intercom 1000 Single Precision Edwards and Kelcey, Engineers and Consultants

Originator: Edwards and Kelcey, Engineer
Date: March 1959

This program gives a preliminary estimate of the practical and possible traffic capacity of one-way or two-way streets under a variety of parking conditions, turning movements, areas, street widths, etc. It does not allow for separate turning lanes, special signal phasing or bus stops.

The required input is as follows:

- 1. Street Number (for identification purposes only)
- 2. Approach Volume (D.H.V. or A.D.T.)
- 3. Ratio, D.H.V. to A.D.T.
- 4. Directional Distribution (for 2-way streets only)
- 5. Amount of Trucks and Busses (% or hourly volume)
- 6. Amount of Left Turns (% or hourly volume)
- 7. Amount of Right Turns (% or hourly volume)
- 8. As many of the following conditions as desired may be analyzed:

Two-Way Streets A. Downtown - With Parking B. Downtown - No Parking C. Fringe - No Parking D. Residential - With Parking E. Residential - No Parking K. Fringe - Parking 2 Sides J. Downtown - Parking Left only J. Downtown - No Parking K. Fringe - Parking 2 Sides L. Fringe - Parking 1 Side M. Fringe - No Parking

- 9. Existing Street Width
- 10. Up to 3 proposed street widths may be entered
- 11. Area Factor (to adjust capacity up or down for local conditions)
- 12. % Green (known or estimated)

Stored in memorary are capacities for every street width (in 1 foot increments) for every condition listed in 8) above. These capacities are for 20% turning-movements and 10% trucks and busses. They were scaled from curves given in the article by 0.K. Norman in the July 1958 issue of Traffic Quarterly and also from the "Highway Capacity Manual" published by B.P.R. (adjusted to be compatible with the new data).

For every width entered and each condition specified, the program computes the practical and possible capacity on the basis of actual turns as given, if no left turns are allowed, and if no turns are allowed. The method used is in accordance with the B.P.R. "Highway Capacity Manual."

The output format is:

	•						
	Str	eet Numb	er	Width _	-	Conditio	n
		<u>Pra</u>	ctical	Capacity	P	ossible	Capacity
		Hourly	Daily	Req'd.% Green	Hourly	Daily	Req'd.% Green
Turns	as Given					-	
If No	Left Turn			400	**************************************		
If No	Turns					-	

A flag type out occurs if the width is not on the table. Computation time averages 2 minutes per condition per width and no accessory equipment is required.

USERS! PROJECT NO. 290

ABSTRACT

A mathematical analysis of a distillation process has as its purpose the determination for a given set of circumstances the conditions which obtain at the various significant places within the distillation apparatus. Consideration of various sets of conditions permits the selection of an economical column design for a given separation and can guide the operation of a given column to give the most effective separation.

Binary mixtures were the subject of the first mathematical theory of the rectifying column. (Sorel, La rectification de l'alcool, Paris, 1893). Sorel studied each plate in a column separately, assuming equilibrium at each plate. He took into account heat and material balances in relating each plate to the adjacent ones.

While Sorel's mathematical treatment of the rectifying column gives the most exact results, it is usually expedient to make simplifying assumptions. The usual ones are constant relative volatility and constant molal overflow. Where the simplifying assumptions introduce serious error it is necessary to use the more elaborate calculations taking into account the heat balance to determine the molal overflow. Use of an internally programmed digital computer makes this easy to do.

This program uses a simplified heat balance calculation. Where adequate fundamental data are available, one could use an exact heat balance calculation, without fundamentally changing the method. No attempt is made to calculate the relative volatility—the program leaves to the operator the task of inserting the correct values.

This program enables the operator to calculate plate by plate the compositions of the liquid and vapor phases and their quantities for a binary liquid mixture, where the relative volatility changes with composition, and where the molal heats of vaporization of the two constituents are so different as to significantly change the molal overflow from plate to plate.

Operation time: One minute per plate.

Velsicol Chemical Corporation 330 East Grand Avenue Chicago, Illinois

Users' Project No. 291

KELVIN FUNCTIONS

Class I

Purpose: This is a subroutine written in Intercom 1000-D that computes ber(x), bei(x), ker(x), kei(x), and their first derivatives. The envolved series are expanded about zero, and computed by a recurrence formula.

Storage:

	Channel	Words	
log x subroutine	any one	00-99	
Kelvin subroutine	any one	00-99	
results	05	76 - u7	

Limitations:

- a) $+0 < x < +\infty$
- b) When x = 0, the log x subroutine will not operate.
- c) When $x \to \infty$, overflow will occur.
- d) Both Mark & Returns (26 & 28) commands are used.

Accuracy: For .001 < x < 10

ber(x), bei(x), ber'(x), bei'(x) are accurate to the last digit. $\ker(x)$, $\ker(x)$, $\ker'(x)$, $\ker'(x)$, $\ker'(x)$ are occasionally in error only in the last digit.

Time: x .001

x	Seconds
.001	35
.010	50
.100	50
1.000	75
10.000	175

Prepared By: U. S. Army

Snow Ice Permafrost Research Establishment

1215 Washington Avenue Wilmette, Illinois

Date: April 20, 1959

ABSTRACT	OF	USERS!	PROJECT	NO	292		
				CLASS		2	

Title: Design of Rectangular Tied Reinforced Concrete Columns, Ultimate Strength Theory.

Originator: Ellerbe and Company, Architects and Engineers

Address: 333 Sibley Street, St. Paul 1, Minnesota

Mode: Intercom 1000, Single Precision

Date: April 1, 1959

Given the dead load and total load applied at the top of a column and the estimated dimensions of the column, this program selects the required vertical steel. If the percent of steel area falls outside the code limits, the column dimensions are adjusted.

The method of solution follows the ACI Building Code 318-56 Appendix on Ultimate Strength Design.

If the percentage of steel exceeds the allowable, the column dimensions are increased until an allowable percentage is found. If the percentage is below the minimum, the minimum steel is typed out, the column dimensions reduced and the column recomputed until the percentage exceeds the minimum. One dimension of the column can be held constant if desired. The weight of the column is computed and included.

The program will handle one column at a time up to 32 stories high. The maximum steel selection stored in memory is 20 number 11 bars.

The input at each story is the increment of dead load and total load, bending moment, column dimensions and story height. Also f'_c , f_v , P_t min. and P_t max.

The output includes weight of column, accumulated dead load, accumulated total load, design load, column dimensions, load carried by steel, percentage of steel, number and size of bars.

The type-in time is about 1/2 min. for each story. The computing time is about 1-1/2 min. for each story.

No auxiliary equipment is used.

SUPPLEMENT NO. 1

0T

ABSTRACT OF USERS! PROJECT NO. 292

CLASS 2

Title:

Design of Rectangular Tied Reinforced Concrete

Columns, Ultimate Strength Theory.

Originator:

Ellerbe and Company

Architects and Engineers

333 Sibley Street St. Paul 1, Minnesota

Intercom 1000, Single Precision

September 29, 1959

The program uses the formulae that apply to the case of compression failure. The Engineer must take into account the possibility of bending failure.

To assist the Engineer in detecting the possibility of bending failure, a check has been incorporated in the program. After the typeout of the design has been completed, the value of

 $\frac{Pu}{t^2}$ f'c is computed. If this value is less than 0.5, the tompression formulae may not apply.

If $\frac{Pu}{t^2}$ f'c is less than 0.5, the value is typed out before the program goes on to the next story. When this value is typed out the Engineer should investigate.

 $\frac{Pu}{t^2}$ f'c is computed and stored in location 1225 and may be examined manually if desired.

USERS! PROJECT NO. 293

ABS TRACT

This manual is hereby presented to the Bendix G=15D Users Exchange Organization. It may be used or published as the organization wishes.

The concept of fixed point scaling which is presented herein is a classic method, and is well suited to scientific use. There are other methods of handling fixed point operation, and this same method can be defined another way. This particular method is favored by the author as being straightforward and as requiring a minimum of study.

This manual covers the important features of fixed point storage, arithmetic, input and output. The coverage of some of the features is rather brief. However, enough information is provided to encourage thought and experimentation on the computer. With that understanding, then, this manual is a study outline for those who wish to program in fixed point.

The author wishes to thank Mr. Raymond Walls of Bendix Computer for instruction on the theory and practice of input conversion routines. For criticism of the text and helpful suggestions on the arrangement of descriptive matter, the author is indebted to Messrs. Laurence English and Donald Johnson of Butler Manufacturing Company and Messrs. Keith Blann and Harry Lorch of Bendix Computer.

Ralph T. Smith
Computer Project Engineer
Butler Manufacturing Company

RTS MM 4-20-59

USERS! PROJECT NO. 294

ABS TRACT

Definition of problem: To determine the actual design moments for a rigid frame pier of 2 to 5 bays with a haunched cap and a continuous footing.

Method of solution: The haunched cap is provided for by coefficients (Locations 1475 thru 1478) taken from the Handbook of Frame Constants. (See sheet of coeff.s) Frame moments are determined by moment distribution. Moments @ the face of column and max. * moments are computed according to the method shown in Continuity in Concrete Building Frames by Portland Cement Assn.

Limitations: The columns must be rectangular and of uniform cross section. The footing must be continuous and is loaded with a uniform load. The columns are assumed fully fixed at the footing. There may be no more than 3 concentrated loads per bay. There is no provision for moments due to wind, side sway, or a longitudinal force. Shrinkage must be included as part of the temperature drop.

Approx. computation plus type out time: (Both output sheets)

2	b ays	30	min.
3	bays	40	min.
4	bays	50	min.
5	bays	60	min.

RICHARDSON, GORDON AND ASSOCIATES

CONSULTING ENGINEERS

3 GATEWAY CENTER PITTSBURGH 22. PA.

3 PENN CENTER PLAZA PHILADELPHIA 2, PA.

PITTSBURGH

Abstract of U.P. No. 295 Class 2

Title:

ANALYSIS OF THE THREE SPAN CONTINUOUS TRUSS

Originator:

Richardson, Gordon and Associates

Address:

3 Gateway Center, Pittsburgh 22, Pennsylvania

Mode:

Machine Language S.P. and D.P. - No Auxiliary Equipment Req'd.

Date: April 20, 1959

- 1. Definition of Problem. To compute length and D.L. and Max. \pm L. L. stresses of every member of the three span continuous truss. For the design of shoes and substructure, the program also computes the D. L. and Max. \pm L. L. reactions. The diagonal system of the three span truss could be either Pratt, Warren, Howe or any combination of the three. No symmetry of the structure is required. Chords can be parallel or non-parallel.
- 2. <u>Input Data</u>. (a) Elevations of every truss joint, (b) Panel length of each span, (c) Distortion area of every truss member, (d) Truss panel point dead loads, and (e) Design uniform and concentrated live loads.
- 3. Output. (a) Length of members, (b) Dead load and maximum + live load reactions, (c) Dead load and maximum + live load stresses in every member, (d) Influence line ordinates and areas for reactions and for stresses in every member.
- 4. Mathematical Method. The three span continuous truss is divided into three simple spans and the moments at the interior supports are solved as redundants by the principle of continuity. Matrix algebra, Maxwell's Reciprocal Principle, Virtual Work, and Method of Conjugate Beam are all used in the program. Maximum + live load stress and reactions are computed by loading the total positive or negative areas under each influence line which is defined by its ordinates.
- 5. <u>Limitations</u>. A maximum of 30 panels for each span or a total of 90 panels are allowed. The program will not handle K or subdivided panel type of diagonal systems.
- 6. Coding. The basic program has about 3500 instructions plus 1500 storage locations for input, output, and intermediate data storage. It executes approximately 200 instructions per second. Total computing time depends on total number of panels and type of output required. For a bridge of 30 panels computing time is 1-1/2 hours for minimum typeout and $\frac{4}{2}$ hours for complete typeout. If the bridge is symetrical only half the above time is required.

PROGRAM ABSTRACT

Program: Arc Intersections

Class: 2

Mode: Intercom 1000 (D.P.)

Originator: Parsons, Brinckerhoff, Hall & Macdonald

March 27, 1959

This program consists of three independent routines for computing data defining points of intersection of straight lines and arcs.

- A. Arc-Parallel Line Solution: Given the radius of an arc, the perpendicular distance between two parallel lines intersecting the arc, and the station and skew angle at the intersection of the arc with one of the parallel lines; this routine computes the station and skew angle at the intersection of the arc and the second parallel line. Stationing, measured along the arc, may be either increasing or decreasing from the known to the unknown intersection.
- B. Arc-Line Solution: This routine computes data defining the intersection of a circular curve and a straight line. The curve data which must be given are the radius, center coordinates, PC station, and the bearing of the tangent back of the PC. Data given defining the intersecting line are either the coordinates of two points on the line and the station of one of these points, or the coordinates and station of one point on the line and the bearing of the line. Stationing may increase or decrease along the arc or line.

For the two theoretical intersections of the arc and line, this routine produces the station of the intersection point as measured along both the arc and line, the skew angle of the intersection, and the coordinates of the intersection point.

C. Two Arc Solution: This routine computes data defining the intersection of two circular curves. Curve data which must be given on both curves are the radius, center coordinates, PC station, and bearing of the tangent back of the PC.

For the two theoretical intersections of the arcs, this routine produces the station of the intersection point in both curve stationing systems, the skew angle of the intersection, and the coordinates of the point of intersection.

PROGRAM ABSTRACT

Program: Three-Point Arc

Class: 2

Mode: Intercom 1000 (T.A.M. #24A)

Originator: Parsons, Brinckerhoff, Hall & Macdonald

March 27, 1959

Given any three known points, not on a line, this program computes the radius of the circular arc determined by these points and the coordinates of the center of curvature.

Two input options are included. In Option 1, the three points are defined by stations and offsets from an established, straight base line. For this option the required input items are the bearing of the base line, station and coordinates of a point on the base line, and the station and offset distance of the three points determining the arc.

In Option 2, the three points are defined by their coordinates.

The relative position of the three points, the order in which they are given, the relative position of the base line and any one point, and the relative position of the base line reference point and the stationing of any one of the three points - all have no significance.

APPLICATIONS SECTION

Users' Project No. 298

SOIL TEST ANALYSIS

It is required to determine the Highway Research Board and grain size classification of a soil. Laboratory tests have been made and the weights of cans, wet soil in cans, dry soil in cans, soil retained on sieves, hydrometer and time readings have been recorded. This is ASTM standard test procedure.

The program calculates the Atterburg Limits, Sieve analysis, hydrometer analysis, grain size classification and Highway Research Board classification, for a soil, from the basic laboratory data.

APPLICATIONS SECTION Users' Project No. 299

REINFORCEMENT BAR LIST WEIGHTS

Given a reinforcement bar list consisting of number, size and length of each bar, the program computes and types out the size and the number of bars for that size, the total length for that size and the total weight for that size; the sizes are standard weight and range from #2 to #11. If no bars for any size are entered, the size is typed out and its corresponding values are typed out as zeros, i.e. there are always 10 lines of type out followed by the weight of the total bar list.

APPLICATIONS SECTION Users' Project No. 300

EARTHWORK VOLUME FROM ELEVATIONS ON A UNIFORM GRID

This program was developed so as to eliminate the need for drawing cross sections through an area which has already been contoured (existing and proposed) on the construction plans. The accuracy of the results depends upon the uniform grid interval. Elevation of existing ground and proposed ground at each grid line intersection are required. Coordinates of the boundary are needed for computation of the surface area.

Borrow Pit computation, Interchange Earthwork or Subdivision Earthwork are examples of the use of this program.

APPLICATIONS SECTION

Users' Project No. 301

INTERCHANGE GEOMETRY - CASE VII MODIFIED DIAMOND

The program calculates the Horizontal Geometry Data required for survey and construction drawings for one quadrant of a modified diamond interchange. Three or less circular curves, two tangent sections and an optional taper off the main route compose the ramp lay out. The radii, tangent lengths and ramp tie point to the cross road are part of the input. The output consists of ramp stationing, station equations, nose stationing, curve data, coordinates of 21 points and offsets to PI's and to the center of the curves. The intersecting highways are on tangent, although in some situations a few prehand calculations will be all that is required for use on curved highways.

APPLICATIONS SECTION

Users' Project No. 302

CULVERT ANALYSIS

This program will compute the moments in a member at the joints of a single (double) (triple) box culvert due to Dead Load, Live Load and Soil Pressure.

A common method of solution is analysis by moment distribution. Application Section Users' Project No. 2 written by Basil Mikhalkin is a program for the solution of moment distribution. As a subroutine of this program A.S. No. 2 is used for the distribution of fixed end moments and sideway correction. Only eleven pieces of input data are required: span and height of culvert, wall thicknesses and value of the loads. Type out is in floating point, bending moment sign convention and positioned such that it may be used directly in final design calculations.

USERS! PROJECT NO. 303

ABSTRACT

USER:

Fellows Gear Shaper Company

CONTACT:

Ben Bloomfield

DATE:

April 22, 1959

TITLE:

Incomplete Elliptic Integral

DESCRIPTION:

This program will compute the incomplete elliptic

integral

 $E(K, \theta) = \sqrt{1 - K^2 \sin^2 \theta d \theta}$

using the Gaussian 10 - point quadrature method. Main program must store sine and square root routines (Bendix

no. 202.0) in line Ol, K^2 (no scale) in 20.1.

 $\frac{\Theta^{\circ}}{\Theta^{\circ}}$ or $(\frac{\Theta \text{ rad}}{\Theta^{\circ}})$ in 20.2. Entry is in word 48, exit from

 $\frac{1}{360}$ 2π

word 49. Answer, scaled 2-1, will be in 20.3.

STATUS:

April 21, 1959, submitted.

Abstract of Users Project No. 304

Class 1

Title:

CONVERSION OF LAMBERT COORDINATES TO GEOGRAPHIC

POSITION AND VICE VERSA FOR CALIFORNIA

Originator:

U. S. Army Engineer District, Los Angeles

Corps of Engineers

Address:

751 South Figueroa Street, Los Angeles 17, California

Mode:

Intercom 201 (DAISY)

Date:

January 1959

This program computes Lambert coordinates from geographic positions and geographic positions from Lambert coordinates.

Input data is in floating point decimal system. Output data is in the fixed point decimal system. Accuracy is to 12 significant figures. Program is valid for a maximum of 22 conversions.

The formulas used are as set forth in Special Publications No. 253, "Plane Coordinate Projection Tables, California (Lambert)" and Special Publications No. 67, "Latitude Developments Connected with Geodesy and Cartography with Tables, Including a Table for Lambert Equal-Area Meridianal Projection" by U. S. Department of Commerce, Coast and Geodetic Survey.

For a maximum number of cases 310 cells of storage are used for input data and 14 cells are used for generated data. Program is located in cells 000 to 387, inclusive. The time required for the computation of one case is about 1 minute.

This program is valid for California zones but is adaptable to other states using the Lambert projection with 7 or less zones. The data for each zone may be entered as constants when necessary.

No auxiliary equipment is used.

J. E. GREINER COMPANY

Baltimore, Maryland

ABSTRACT

of

Structural Design of Single Cell Box Culvert Program

User's Project No. 305

This Intercom 101 program analyzes and designs a single cell box culvert in accordance with AASHO, 1957 Standard Specifications for Highway Bridges. The analysis is done by the Slope Deflection method. Live loads used are H20-44 and H20-S16-44. Either yielding or unyielding foundations may be considered. This program cannot be used for boxes with structural haunches.

Thirteen items of input must be entered, including inside width and height of box, depth of fill over box, unit weight and equivalent fluid pressure of earth, estimated thickness of top and bottom slabs and wall, and allowable steel and concrete stresses.

There are twenty items of output, including corner and interior moments, shears, direct load on the wall, required thickness of all members and area of reinforcing steel per lineal foot of box required at corners and centers of all members.

Running time varies from five to seven minutes depending upon how often the estimated input thicknesses must be incremented to reach the thicknesses required by either moment or shear. No decrementing of thicknesses occurs.

ABSTRACT

Users' Project No. 306

INTERCHANGE GEOMETRY - ONE QUANDRANT DIAMOND LAYOUT, CASE VI

The Program calculates the geometry for one quadrant of a diamond interchange when the Intersecting Highways are on tangent and the outer connection portion of the ramp does not contain a reverse curve. Each curve may be made up of one circular curve connected to the tangent portions with spirals. The use of spirals is optional. The end tangents must be parallel to the Intersecting Highways.

Ramp stationing, station equations, spiral and circular curve data and tangent section lengths are computed. In addition tests for curve overlap are incorporated in this program. The tangents at the ends of the outer connection portion of the diamond are parallel to the highways or to any other line which is being used as a reference.

This program can be modified by the operator to compute the geometry for the "Dog leg" ramp. The orders which need to be added are shown in the coding sheets.

Abstract of Users Project No. 307

Class 1

Title: GEOGRAPHIC POSITIONS TO TRANSVERSE MERCATOR PLANE

COORDINATES AND VICE VERSA (FOR ARIZONA)

Originator: U. S. Army Engineer District, Los Angeles

Corps of Engineers

Address: 751 South Figueroa Street, Los Angeles 17, California

Mode: Intercom 201 (DAISY)

Date: January 1959

This program computes transverse Mercator plane coordinates from geographic positions and geographic positions from transverse Mercator plane coordinates.

Input data is in floating point decimal system. Output data is in the fixed point decimal system. Accuracy is to 12 significant figures. Program is valid for a maximum of 100 conversions.

The formulas used are set forth in Special Publications No. 257, "Plane Coordinate Projection Tables Arizona Transverse Mercator" and Special Publications No. 195, "Manual of Traverse Computation on the Transverse Mercator Grid" by U. S. Department of Commerce, Coast and Geodetic Súrvey.

For a maximum number of cases 600 cells of storage are used for input data and 30 cells are used for generated data. Program is located in cells 000 to 378, inclusive. The time required for the computation of one case is about 1 minute.

This program is valid only for Arizona zones but is adaptable to other states using transverse Mercator projection. The data for each zone may be entered as constants when necessary.

No auxiliary equipment is used.

LOCKWOOD, KESSLER & BARTLETT, INC.

ENGINEERS • SURVEYORS

ONE AERIAL WAY, SYOSSET, NEW YORK

WELLS 8-0600

Users' Project No. 308

abstract

Title:

Triangles

Class:

Mode:

Intercom 1000 dp

Originator: LOCKWOOD, KESSLER & BARTLETT, INC.

Date:

May, 1959

The program consists of four independent parts. The data may be located in any one of four quardrants.

Part I: Two Distances

The coordinates of two corners of a triangle and the bearings from the corners are given. Determine; the coordinates of 3rd corner and the distances from the two corners. Computation time: 50 sec.

Part II: Bearing and Distance

The coordinates of two corners of a triangle, the bearing from the 1st to 3rd corners, and the distance from the 2nd to the 3rd corners are known. Find; the coordinates of the 3rd corner, the distances between the 1st and 3rd corners, and the bearings from the 2nd to the 3rd corners, of two solutions. Computation time: 1 min 45 sec.

Part III: Two Bearings

The coordinates of two corners of a triangle and the distances from the two corners to 3rd corner are known. Determine: the distance between the two known corners, the interior engles of the two corners, the coordinates of the 3rd corner, and the bearings from each corner to the 3rd corner, of two solutions. Computation time: 4 min 20 sec.

Part IV: Interior Angles

The lengths of three sides of a triangle are given. Find; three interior angles of the triangle. Computation time: 1 min 30 sec.

The program has been designed for type or Flex tape input data.

TITLE: Geometry and Elevations of Tangent and Spiral Curved Bridges

CLASS: 2

MODE: Intercom 1000

ORIGINATOR: H. W. Lochner, Inc.

DATE: May 8, 1959

Given a highway bridge on a spiral alignment referenced to the spiral tangent base line, this program will compute geometric relationships between the bridge and the spiral, elevations and flag any portion of the bridge lying within an adjacent circle. For a bridge laying entirely on the tangent, this program computes elevations and additional references to the base line.

The spiral formula is solved by successive approximations to any accuracy desired. Tangent area points are solved directly and independently of the spiral solution and tangent dimensions, stations and applied grade elevations are typed out. The program also computes roadway and related elevations through superelevated or transitional sections of the structure.

The operation of the program is divided into two sections.

Input to Section 1 - Horizontal Geometry and Applied Grade Elevations. The input for this section includes properties of the horizontal and vertical alignments. Distances from skew lines, such as pier center line, bearing center line, back of abutment, etc., to T. S. Station, skew angle and stringer locations along skew lines or perpendicular distances from base line to concentric curves, such as sidewalks, parapets, etc., complete this input. For the purpose of this program, intersections of skew lines with concentric curves are called coordinates.

Output for Section 1 consists of dimensions locating each stringer or coordinate and station and applied grade elevation for intersection points within the spiral and tangent areas. Points in the adjacent circle area are flagged by a negative length typeout giving the approximate distance into the circle area. It also stores into tape some of the data required for the operation of Section 2 of the program.

Input to Section 2 - Roadway and Structure Elevations
The input for this section includes data stored on punched tape from Section 1, such as stations, applied grade elevations and perpendicular distances to base line. Additional input includes lane widths, parabolic crown and superelevation properties and distance from base line to applied grade lines.

Output for Section 2 consists of elevations for roadway, stringer, curbs, parapets, etc., throughout the structure taking into account crowned, superelevated or transitional pavements. A zero elevation typeout flags circle area points.

Limitations

Any skew line should not contain more than 17 stringers or coordinates. Each bridge should not have more than five lanes on each side of the base line.

Each lane should not have more than 3 superelevation transitions. Vertical alignment should not contain more than five vertical curves.

Subroutines used:

sin, cos, flexowriter

Auxiliary equipment used:

none

Computation time:

1 skew line, 17 stringers or coordinates,

includes typeout and punch out.

Spiral curved bridge: Tangent bridge:

Section 1
17 min.
5 min.

Section 2
10 min.
10 min.

Abstract of Users Project No. 310
Class 1

Title:

3-SPAN INFLUENCE LINES

Originator:

ENELCO LIMITED

Address:

164 Eglinton Avenue East Toronto 12, Ontario, Canada

Mode:

Intercom 101

Date:

January, 1959

Given span and inertia values, this program computes support moments, reactions and midspan moments for a moving unit load.

Input consists of 3 span and 30 inertia values.

Load locations for moving unit load are at 0.05 L, 0.15 L, 0.25 L, etc. in each span.

Output format is shown in operating instructions.

The first typeout contains the support moments, the second the reactions, and the third the midspan moments, all tabulated relating to load positions.

The moments are calculated by three moment equations taking into account the variable inertia values.

Data input requires typein and punchout of 33 floating point figures.

Operation time: approx. 20 minutes.

Abstract of Users' Project No. 311 Class 1

Title:

4-SPAN INFLUENCE LINES

Originator:

ENELCO LIMITED

Address:

164 Eglinton Avenue East, Toronto 12, Canada

Mode:

Accessories: Magnetic tape storage unit

Given span and inertia values, this program computes support moments, reactions, and midspan moments for a moving unit load.

Input consists of 4 span and 40 inertia values.

Load locations for the moving unit load are at 0.05 L, 0.15 L, 0.25L, etc. in each span.

Output format is shown in the operating instructions.

The first typeout contains the support moments, the second the reactions, and the third the midspan moments, all tabulated relating to load positions.

The moments are calculated by 3 moment equations taking into account the variable inertia values.

Data input requires typein of 50 floating point figures.

Operation time: approx. 30 minutes.

The M-2 magnetic tape storage unit is used, the program being an alteration of the originator's five span influence line routine.

ABSTRACT FOR USERS! PROJECT NO. 312

TITLE: Horizontal Alignment

CLASS:

MODE: Intercom 1000

ORIGINATOR: H. W. Lochner, Inc.

DATE: October, 1958

This program contains in one tape the computations more frequently found in the mathematization of horizontal alignments. The operations which can be computed by this program are the following:

1. Unadjusted Traverse.

2. Particular Adjustment of a Traverse.

3. Distance and Azimuth Between Points.

4. Intersection of Two Lines Given by Their End Coordinates.
5. Intersection of Two Lines Given by Their Azimuths and the Coordinates of One Point on Each Line.

6. Intersection of a Circle and a Straight Line.

7. Determination of Ramp Nose (Straight Line and Circle).

8. Intersection of Two Circles.

9. Determination of Ramp Nose (Circle and Circle).

ABSTRACT FOR USERS' PROJECT NO. 313

CLASS:

2

MODE:

Intercom 1000

ORIGINATOR:

H. W. Lochner & Company

DATE:

September, 1958

Given the scaled values of a traverse containing at least one compound curve the program will find the mathematical elements of the compound curve which will produce a perfect adjustment of the traverse and then compute the complete adjusted data for the traverse.

The traverses leading to the area where the compound curve occurs may be made of straight sides defined by deflection angle and length or curved segments defined by central angle and radius. The total number of sides of these traverses should not exceed 23 sides.

THE DOW CHEMICAL COMPANY

James River Division Williamsburg, Virginia

Class 2

Title:

Fourier Coefficients

Originator:

The Dow Chemical Company

Williamsburg, Virginia

April 22, 1959

Mode:

Intercom 103

ABSTRACT OF USERS PROJECT

Given a function U(X) which takes the values U_0 , U_1 ,... U_{n-1} when X takes the values 0, $\frac{2}{n}$, ... $\frac{2(n-1)}{n}$ where n>2r,

$$A_{0} = \frac{1}{n} \qquad \sum_{K=0}^{n-1} U_{K}$$

$$A_{1} = \frac{2}{n} \qquad \sum_{K=0}^{N-1} U_{K} \cos \frac{2 \pi K}{n}$$

$$A_{r} = \frac{2}{n} \qquad \sum_{K=0}^{N-1} U_{K} \cos \frac{2 \pi Kr}{n}$$

$$B_{1} = \frac{2}{n} \qquad \sum_{K=0}^{N-1} U_{K} \sin \frac{2 \pi Kr}{n}$$

$$B_{r} = \frac{2}{n} \qquad \sum_{K=0}^{N-1} U_{K} \sin \frac{2 \pi Kr}{n}$$

and

$$U(\theta) = A_0 + A_1 \cos \theta + A_2 \cos 2 \theta + \dots A_r \cos r \theta$$
$$+ B_1 \sin \theta + B_2 \sin 2 \theta + \dots A_r \sin r \theta$$

The program considers equally spaced U(X) values, and considers θ = 360° at the nth value of U(X) and θ = 0° at the first value

of U(X) in the data.

Output and format is as follows:

A_0		
1	$^{\mathtt{A}}_{\mathtt{1}}$	^B 1
2	A_2	B ₂
•	•	۰
•	•	•
•	•	• ,
•	•	•
r	$\mathtt{A}_{\mathtt{r}}$	Br

The initial and final values of r and the number of ourputs may be controlled. Operating time about $1\frac{1}{2}$ to 2 minutes per output given 37 data points to work with.

No responsibility is assumed by the Dow Chemical Company for any errors, mistakes or misrepresentations that may occur as the result of using this program and in no event will the Company be liable for such occurrences.

ABSTRACT

USERS' PROJECT NO. 315

TITLE:

Investigation of Circular Reinforced Concrete Columns

CLASS:

2

VALUE:

5

ORIGINATOR:

Midwest Computer Service, Inc., Decatur, Illinois

LANGUAGE:

Intercom 101

DATE:

May 15, 1959

This program will completely investigate a circular reinforced concrete column with axial load and bending. The program types out the geometric properties, axial load and moment capacities of the column, for both uncracked and cracked sections.

The output is in the form of coordinates for a "Design Load Interaction Diagram". These coordinates may then be plotted to produce a family of curves, with varying percentages of steel, for use in the design of circular columns. The investigation is in accordance with ACI or AASHO specifications for both tied or spiral columns.

The program makes use of Users' Project 43 to solve for stresses in the region of a cracked section. Therefore, the same method of analysis is used as for Users' Project 43 with a revision for the use of 2n-1 or 2(n-1) for the effectiveness of the compression steel.

The program is written in Intercom 101 and uses the 101 trig subroutines.

Total machine time for one curve for one column is 10 minutes.

ABS TRACT

USERS! PROJECT NO. 316

This program transforms the coordinates of points in a given coordinate system into a second coordinate system, and adjusts for a given scale difference.

The two coordinate systems are defined by a common point of known coordinates with respect to each system and by the angle of "rotation" measured from the second system to the original system.

The output includes all of the original input data and the calculated coordinates.

Class 2

Title: Critical Point Station and Elevation

Originator: Edwards and Kelcey, Engineers and Consultants

Address: 3 William Street, Newark, New Jersey

Mode: Intercom 1000 Double Precision

Date: May 29, 1959

Given two edge lines located by a known offset from two baselines, this program will solve for the point of intersection of the edge lines, project it onto both baselines, and find the corresponding baseline stations. An option is provided for supplying vertical control data for one of the baselines and obtaining the elevation of the PI projection on that baseline.

The program was written to assist in establishing vertical control at critical bridge clearance points. At present the program can handle two types of horizontal alignments; either both edge lines on tangents or one on a tangent and the other on a simple circular curve. In both cases the edge line must be parallel or concentric with its corresponding baselines. All coordinates must lie in the northeast quadrant: -i.e. north and east coordinates must be positive. Since the arctangent subroutine is used, a loss in accuracy occurs at very small angles.

The required input consists of station and coordinates of a point on each baseline back of the PI, the bearings of the baselines (or tangent bearing if on a curve), the offsets from baselines to edge lines, various codes controlling the logic, and if desired, vertical control data for one baseline. The output consists of both baseline stations and one elevation if it has been asked for. Input time takes about five minutes and computation time from 45 to 90 seconds. All available channels are used.

U. S. NAVAL AIR DEVELOPMENT CENTER JOHNSVILLE, PENNSYLVANIA

Abstract of Users Project No. 318

Title: Pogo Subroutine Package

Class: 1 Mode: Pogo

Originator: Aeronautical Computer Laboratory, NADEVCEN, Johnsville, Pa.

Date: 29 May 1959

This package consists of the following six fixed point, single precision subroutines plus a selective loader:

1.
$$\sin^{-1} x$$
, \sqrt{x}

- 2. e^X
- 3. $\sin \Theta$, $\cos \Theta$ \sqrt{x}
- 4. $tan^{-1}x$, \sqrt{x}
- 5. Format Control, \sqrt{x}
- 6. $\log_{10}x$, $\log_e x$

The selective loader provides a means of loading desired subroutines into a specified portion of the G-15 memory (lines 06 through 18).

Prior to entry into a subroutine, the argument, x, is placed in accumulator w. Upon exit from the subroutine, the function will be found in accumulator w. With the exception of the AR, the contents of other accumulators remain undisturbed by the execution of these subroutines.

USERS' PROJECT NO. 319

Abstract

SADIE (Intercom 302)

(Single-Precision Adaptation of the Daisy Interpretive & Executive System)

This is a complete interpretive system, similar in many respects to Intercom 101-103, but based on the system used in Daisy 202. Improvements have been added wherever possible to include them. Among these improvements are the following:

- 1. Fixed point output with individually selective format, in basic package.
- 2. Programmed punch tape, in basic package.
- 3. Two sets of place markers.
- 4. Inverse subtract and divide orders.
- 5. Improved decrement register routine.
- 6. Programmed return to Compiler.
- 7. New, high-speed Appendix subroutines, with additional codes.
- 8. Speeded up response to typing.
- 9. Speeded up sequential listing.
- 10. Graph-plotter routine included in appendix.

The average speed of operation is not equal to that of Intercom 101-103, so is not recommended for programs requiring considerable calculation time. However, where fixed-point output is desired, or where graph-plotter operation is needed, or where set-up time and debugging time is an important consideration, SADIE has proved its usefulness. We hope to make extensive time checks in the future, not only against Intercom 103, but also against Intercom 1000, Single Precision, and to publish the results.

No responsibility is assumed by the author or by Bendix Radio Division for any errors, mistakes, or misrepresentations that may occur during computations when using this program; furthermore, no responsibility is assumed by Bendix Computer Division for the correct reproduction of the program.



INTERCOM 1000 DOCUMENTATION ROUTINE Machine-Language Program for G-15D

Abstract USERS' PROJECT NO. 320

This program was written to aid the programmer in documenting his checked out INTERCOM 1000 programs. There is no dependence on INTERCOM since the program is written in machine language and has a self-loading feature. It operates from command lines 00 and 02.

Program tapes are read into long line 10 one block at a time. Each command is then typed out in standard form directly on standard coding sheets. A built-in counter lists the commands from 00 to 99 as they are typed out. Halts which allow time for placing the tapes of program to be read on the photo-reader as well as time to change coding sheets on the typewriter are built into the routine. Only commands can be typed out; hence, any constants which occur in the routine will not appear in proper form.

About 7 minutes are required to document one long line of commands.

Title: STORM SEWER DESIGN - RATIONAL METHOD FOR URBAN EXPRESSWAYS

Class: 1

Mode: Intercom 1000S

Originator: Cook County Highway Department

Date: June 16, 1959

On an urban expressway of known pavement profile with a given Right Of Way area which may be broken down into 50 separate drainage areas, each of which can be further reduced to four incremental areas according to topography or runoff rate, this program will provide the main drain storm sewer pipe sizes to carry the computed amount of runoff from each point of introduction to the next point of introduction. eventually arriving at the outfall for the entire length. The designer is allowed to vary the shape and material of the conduit by entering as constants the hydraulic properties of the pipe used. He is also permitted to select the desireable velocities, or he may determine the velocities resulting from a given hydraulic gradient according to the physical characteristics of the pavement profile. The program will automatically increment to the next larger pipe size once the capacity of each size is exceeded. The pipe sizes to be used are determined by the designer and listed according to their shape and hydraulic characteristics as data in the order of increasing sizes.

The program computes rainfall intensity by the formula $i = a/(t^{b}+c)$ and allows the selection of four fractional runoff coefficients and the intensity formula constant as data. The incremental areas of each drainage area in acres are given as data.

The computer will initially compute, type, and store the velocities of all pipe sizes entered if the designer requires this information for checking before allowing further computation to proceed. When found acceptable, the computer is allowed to proceed to totalize and determine a weighted runoff coefficient for each drainage area and a cumulative runoff coefficient for the total area to that point. These values are also typed and stored. The next portion of the program will compute Q discharges in cubic feet per second for the area to that point, the rainfall intensity in inches per hour, the inlet time, the travel time between points of introduction, the velocity, and the maximum hydraulic capacity of the pipe sizes provided in the program to carry the computed Q. Finally when all areas have been considered, the program will compute and type the slope of each pipe size supplied by the designer to check on the original input data and also provide the information if it had not previously been determined in the case where pipe velocity only was selected.

A program of 50 drainage areas or 200 incremental areas requires approximately 2 hours of machine time, including data input. Before using the computer the designer should analyze the conditions of flow in the outfall stream as to elevation of high water, time of storm at which this high water occurs, and position of the outfall headwall of the proposed sewer so that the proper design conditions may be included in the program allowing for conditions of flow in the designed sewer of flowing full or partially full.

ABS TRACT

Users' Project No. 322

EXPERIMENT INCORPORATED

RICHMOND 2, VIRGINIA

Title:

MACH TABLE FUNCTIONS SUBROUTINE

Originator:

Experiment Incorporated

Address:

Box 1-T

Richmond 2, Virginia

Date:

June 29, 1959

Mode:

Intercom 1000 Single Precision

Equipment

Used:

G-15D

Subroutines

Used:

Square Root Logarithmic Exponential

Description:

Given any Mach number this one channel program can be used as a subroutine to calculate any of the following functions, each as a function of mach number:

Temperature Ratio Pressure Ratio Density Ratio

Stream Thrust Ratio Mass Flow Functions

Ratio of Dynamic Pressure to Static Pressure

Area Ratio

Mach Number Relation across a Normal Shock

The function to be calculated is determined by varying the word limit of an index register.

Limitations:

The initial mach number cannot be equal to zero in calculating stream thrust ratio and area ratio. Overflow would occur due to division by zero.

Input:

The only input required is the value of γ to be used. Whether it be 7/5 or 9/7 it is entered into the first data location in the mach function subroutine. The mach number needed to enter the subroutine will be brought into AR from the body of the main program.

Output:

At the completion of the subroutine the calculated value of the function is found in AR.

Operating Time:

The operating time of the mach function subroutine varies from 3 to 9 seconds depending on the desired function.

THE DOW CHEMICAL COMPANY

James River Division Williamsburg, Virginia

Class 2

Title:

Period Search

Originator:

Dow Chemical Company Williamsburg, Virginia

June 23, 1959

Mode:

Intercom 103

ABSTRACT OF USERS PROJECT No. 323

Given a series of equally spaced values Y(t) the program examines the matrix,

The variance of the columns of this matrix is compared with the over-all variance of the entire set. Output is the ratio of variance of columns/variance of set. The program is normally set to begin with p=2 and continue to p=5. However, these values may be changed by setting appropriate registers.

Assuming a set of random numbers, all variance ratios should approach one. Given a period p superimposed on the random number set, the variance ratios will be greater than one when the p by m matrix is examined and less than one for other values.

USERS PROJECT NO. 324

PROGRAM ABSTRACT

This program operates under the control of Intercomm 1000 D. It provides a conventional analysis-of-variance table for the data pattern of R rows by C column with r replications at each row-column intersection. The limits are 25 rows, 25 columns, and replications of 2, 3, or 4. Inspection of the data is available through the optional outputs of row sums, column sums, within-replications variance estimates by rows, and within-replications variance estimate by columns. No missing entries can be tolerated; a substitution procedure is suggested when necessary. The program may be utilized to calculate ASTM Repeatability and Reproducibility either by manual table look-up or by use of Paulson's and the Hilferty-Wilson approximations to the necessary critical variance ratios. After final results are listed, the program resets itself for a new load; as long as the same data pattern applies to successive loads, they may be processed continuously without reloading the control toggles or critical variance ratios.

The tape submitted contains the Intercom 1000 D subroutines for square root and card input according to the May, 1959, version. The illustrative problem has been run with both the May, 1959, and August, 1958, versions of Intercom 1000 D; the same results were obtained in both instances.

BYDATE	CLIENT	SHEET NO
CHKD. BYDATE	SUBJECT	JOB NO
DEE	Program Abstract	per Prog. No. 110

Users! Project No. 325

CONVEYOR GEOMETRY

This program computes detail geometry of a belt conveyor on a circular curve; and computes the number of stringer lengths and the belt radius of the curve.

Input:

The required input is as shown on the data-form, and further described as follows:

- X & Y Coordinates of the Point of Intersection of the two tangents.
- G1 Tangent of the slope angle at the Tangent-to-Curve point.
- G2 Tangent of the slope angle at the Curve-to-Tangent point.
- R The minimum allowable radius for the curve. A convex curve is indicated by a minus radius (-R), and a concave curve by a plus radius (/R).
- h Height of Idlers, also the minimum distance from the belt to the top of stringer.
- 1 Stringer length, measured at the top of stringer.
- d Distance from the top of stringer to any line of interest parallel to the top of stringer.
- I Total number of idlers on one stringer, (10 Max.)
- cl, c2, etc. Distance along the stringer from the centerline of stringer to the idlers. If an idler is placed on the centerline, set cl = 0.

 Idler spacing is symmetrical.

Output:

Output will be typed on the data form. Except as noted, all dimensions are in feet. The notation is as follows:

- 9 Intersection angle in decimal degrees.
- N Number of stringers on the curve, including one-half stringer at each the TC and CT.
- R(Belt) Belt Radius.
- R(T/Stgr.) Radius tangent to the top of stringer at the centerline of stringer.
- B Bevel of the end of stringer.
- L Length along the structural work-line.
- t(c1), t(c2), etc. Required shim thicknesses of idlers c1, c2, etc.
- G Tangent of the slope angle of the stringer.
- X,Y (T/Stgr.) Coordinates of the end of stringers, TC, or CT.
- X,Y (W.L.) Coordinates of the end of the stringers, TC, or CT, at a distance "d" from the top of stringer.

One line of slope and coordinates will be typed for the TC, each end of stringer and the CT.

CLASS 2

326

TITLE: FLEXIBILITY ANALYSIS OF PIPING SYSTEMS

ORIGINATOR: REYNOLDS, SMITH AND HILLS, ARCHITECTS & ENGINEERS

ADDRESS: 227 PARK ST., JACKSONVILLE, FLORIDA

MODE: INTERCOM 1000 (SINGLE PRECISION)

DATE: JUNE 24, 1959

This program is designed to determine the flexibility characteristics of any piping system composed of an unlimited number of members in as large a problem as a seven anchor system in space. Skewed members may be handled equally as well as members lying within the coordinate plane. These characteristics as determined for the system under thermal expansion are bending moments, torsional moments, combined stresses, and rotations and deflections at selected points.

The general analytical method developed by M. W. Kellogg Company is used to determine the moments and forces at the coordinate origin resulting from thermal expansion within the system branches. Solution of the set of simultaneous equations is handled by Cholesky's method. The maximum size of the symetrical matrix representing the piping system is 39x39.

Input consists of data as described by Kellogg representing each straight, curved, or skewed member of the system. Manual commands representing the system under consideration are also entered as data.

The moments and forces at the coordinate origin for each anchor calculated and the restraint forces, if any, are printed after the solution of the set of simultaneous equations. After further entry of program and data, the moments calculated from the restraints, if any, the bending moments, torsional moments, combined stresses, rotations and deflections at selected points are typed out.

Data input for the maximum size problems requires about four hours. Solution to the set of equations requires five and one half hours, for the maximum size. No auxiliary equipment is required.

ABSTRACT OF USERS' PROJECT NO. 326

SUPPLEMENT

CLASS 2

TITLE: Flexibility Analysis of Piping Systems

Supplement I: Shape Coefficients for Nozzles

Supplement II: Calculation of Section Modulus and Moment of Inertia

Calculation of Flexibility and Stress Intensification

Factors for Pipe Bends

Supplement III: Storage of 7 anchor problem

Supplement IV: Notes for Use of Users' Project 326

ORIGINATOR: Reynolds, Smith and Hills

ADDRESS: 227 Park Street - Jacksonville, Florida

MODE: Intercom 1000-Single Precision

DATE: September 13, 1960

These supplementary programs are designed to augment the general program (U.P. 326).

Supplement I calculates shape coefficients if nozzles are to be considered in the analysis of the piping system. These values are computed, punched out on tape, typed out for examination, and are re-entered for addition during the calculation of the shape coefficients for the general performance matrix.

Flexibility and stress intensification factors for pipe bends are calculated by Supplement II, as well as tables of section modulus and moment of inertia for ranges of wall thickness, which were especially developed for heavy-wall pipe.

The third supplement is a short program to aid in the storage of the performance matrix when a seven anchor problem is encountered. An outline of the order of formation of the initial common branch and anchor branch matrices and the formation of the off-diagonal matrices is given. Supplement IV contains explanatory notes to aid in using the general program.

The input and output formats are shown in the writeup. No auxiliary equipment is required. There is no limit to the number of calculations using Supplement I and II.

Users' Project No. 327

Graph Plotter Subroutine and Service Routine

ABSTRACT

This is a machine language program designed to permit the operation of the Graph Plotter from a program written in Intercom 1000 Double Precision. This program is designed to be added to the Intercom Appendix I package and may be entered into the machine with an NNCHuO command from the appendix tape. It does not destroy index registers in the channel in which it is stored. It is operated from Intercom 1000 DP by storing a positive or negative x increment in CHOO, where CH is the line in which the subroutine is stored, and a positive or negative y increment in the accumulator. Upon executing the Intercom command O8CH47 a straight line will be drawn in the proper direction. As the plotter moves only in integral jumps the largest possible number at 0.01" increments less than the prescribed number are executed and the excess is stored to be added to the next increment so that no accumulative error is made.

A service routine is provided to draw a 5" by 7" rectangle with markers at every one inch on execution of the Intercom command 03 0000. The service routine is optional.

UNIVERSITY OF CALIFORNIA DEPARTMENT OF ENGINEERING LOS ANGELES 24, CALIFORNIA

USERS' PROJECT NO. 328

INTERCOM lolQ

ABSTRACT

Intercom 101Q adds two new operation codes to Intercom 101D while retaining all operation codes and features of 101D. These operation codes make it possible to sample stored data at random, and to generate random fractions in floating point form. In addition, a program preparation code makes it possible to clear the interpretive memory while operating in the compiler mode.

The operation codes rely upon the generation of psuedo-random binary numbers which are obtained by extracting the first 20 bits from the least significant half of a double precision number that is generated by the formula

$$S_{i} = \sqrt{S_{i-1} + \sqrt{S_{i-1}}}$$

where S_i is the ith number generated.

ELLIPTIC INTEGRALS OF FIRST AND SECOND KIND

ABSTRACT

This is an Intercom program written in Intercom 1000 double precision designed to calculate the elliptic integrals of the first and second kind $F(\Theta, \Phi)$ and $E(\Theta, \Phi)$, where the elliptic integrals of the first kind

$$F(\Theta, \Phi) = \int_{0}^{\Phi} \frac{dx}{\sqrt{1 - sin^{2}\Theta sin^{2}x}}$$

and the elliptic integral of the second kind

$$E(\Theta,\Phi) = \int_{0}^{\Phi} \sqrt{1-s_{i}n^{2}\Theta s_{i}n^{2}X} dx$$

This program operates out of line 15 and 16 with the arctan A subroutine in line 17. It is entered by a "mark place II and transfer" command. It is designed to operate for values of O and O (90°. It contains the regular intercom appendix I A subroutine in line 15 and this subroutine may be used by a program independent of the elliptic integral subroutine entered by the ordinary 08 1597 command.

Users' Project No. 330

PROGRAM ABSTRACT

This program operates under the control of Intercomm 1000 D. It provides a conventional analysis-of-variance table for the data pattern of R rows by C column with r replications at each row-column intersection. The limits are 25 rows, 25 columns, and replications of 2, 3, or 4. Inspection of the data is available through the optional outputs of row sums, column sums, within-replications variance estimates by rows, and within-replications variance estimate by columns. No missing entries can be tolerated; a substitution procedure is suggested when necessary. The program may be utilized to calculate ASTM Repeatability and Reproducibility either by manual table look-up or by use of Paulson's and the Hilferty-Wilson approximations to the necessary critical variance ratios. After final results are listed, the program resets itself for a new load; as long as the same data pattern applies to successive loads, they may be processed continuously without reloading the control toggles or critical variance ratios.

The tape submitted contains the Intercom 1000 D subroutines for square root and card input according to the May, 1959, version. The illustrative problem has been run with both the May, 1959, and August, 1958, versions of Intercom 1000 D; the same results were obtained in both instances.

USERS! PROJECT NO. 331

PROGRAM ABSTRACT

GENERAL INTERCOM CURVE-FITTER

This program comprises a modification of Intercom 1000 (24A) combined with a double-precision floating-point matrix inverter to provide a program that can be used to compile the normal equations of a curve-fitting process by means of a pseudocoded program, then to invert the matrix and solve the equations, leaving the answers in position in memory so as to be accessible for use under further pseudocode programs. The pseudocode used is Intercom 1000 (24A) as described in Applications Section Memorandum No. 24A; the matrix inversion and solution of the normal equations proceeds in accordance with Maisie, Users' Project No. 11 Matrix Inverter and Simultaneous Equations Solver. The maximum order of the matrix of normal equations is 12. Six lines (10 through 15) of Intercom 1000 memory are available for compiling the normal equations into definite addresses in lines 16, 17, and 18. On completion of the matrix calculations the solution of the normal equations is found in the addresses for the corresponding vectors; the inverse of the matrix of coefficients is found in the addresses for the corresponding matrix terms.

ABSTRACT OF USERS' PROJECT NO. 332

CLASS 2

TITLE: Simultaneous Equation Solution

ORIGINATOR: Reynolds, Smith and Hills

ADDRESS: 227 Park Street

Jacksonville, Florida

MODE: Intercom 1000 (S. P.)

DATE: 1 July 1959

This program is designed to provide the solution to a set of simultaneous linear equations in which coefficients of the equations can be represented by a symetrical matrix. The program will solve and print results for as large a system as a set of 39 simultaneous equations.

Cholesky's method of elimination is used in the solution of the set of equations. The coefficients and the constants of the equations are typed as input; input being typed as fixed point decimal numbers.

Output which is typed out in fixed point single-precision decimal numbers is the solution to the set of equations.

Abstract of User's Project 333

Title: Rigid Pavement Design

Class: 1

Mode: Intercom 1000 S.P.

Originator: Parsons, Brinckerhoff, Hall & Macdonald

This program produces a design thickness or a list General: of design thicknesses of a cement concrete pavement, given known design conditions and concrete properties. The designer has the option of determining whether he wants a theoretical thickness produced based on a required factor of safety or whether he would prefer a table of designs of a series of pavement thicknesses with the associated stresses and safety factors. Under either option the same method is used to determine the maximum bending stress in the pavement for the loading and its location. To compute these stresses the method of H.M. Westergaard as empirically modified by L.W. Teller and E.C. Sutherland is employed. (Ref. "Stresses in Concrete Pavements Computed by Theoretical Analysis" by H.W. Westergaard, Public Roads, April 1926, Vol. 7, No. 2, pages 25-35: "The Structural Design of Concrete Pavements, Part 5 - An Experimental Study of the Westergaard Analysis of Stress Conditions in Concrete Pavement Slabs of Uniform Thickness," by I.W. Teller and E.C. Sutherland, Public Roads, April-May-June 1943, Vol. 23, No. 8, pages 167-212.) In the analyses referred to, three locations of a single load applied on the slab are considered; on a free corner, on the interior area of the slab, and on a free edge. In addition to these locations, designs may be produced for a load on a protected corner and a protected edge, where load transfer devices such as dowels allow reductions in those capacities required by a free corner or a free edge. The designer may specify a load transfer factor which modifies the basic equations to allow for a protected corner or protected edge.

Input-Output: Input consists of loading code, load transfer factor, load, radius of circular contact area or imprint, modulus of subgrade reaction, modulus of rupture of concrete, factor of safety or increment of pavement thickness, initial pavement thickness, and permissable stress variation or number of designs desired in table. Output under both options consists of pavement thickness, actual tensile stress and resulting factor of safety.

Limitations: The approximate equivalent circular area must first be found for elliptical tire imprints. The equations are valid only in the range where the radius of the area of imprint is less than the radius of relative stiffness.

USERS! PROJECT NO. 334

Title:

"PAPER TAPE TEST ROUTINE"

Class

I

Mode

Machine Language

Originator

Western Electric Engineering Research Center

Date

July, 1959

ABSTRACT

- 1. This program was written to facilitate the debugging of paper tape punching systems. It requires that four-word groups be identical.
- 2. Input is through paper tape. The last four-word group is transferred from M23 to M20 to be used as the standard. Errors are detected by check-summing four-word groups.
- 3. Output is through the typewriter. The error address and error are both typed out. The error will be in standard format.
- 4. A correct block of data can be read in and checked in less than ten seconds.

DISCLAIMER

No responsibility is assumed by Western Electric Engineering Research Center or the author for any errors, mistakes or mis-representations that may occur during computation when using the Paper Tape Test Routine; furthermore, no responsibility is undertaken by Bendix Computer Division for the correct reproduction of this problem.

Abstract of Users Project No. 335

Title:

WIND ROSE DATA REDUCTION

Class:

7

Mode:

Machine Language

Originator:

Tippetts-Abbett-McCarthy-Stratton

Date:

July 15, 1959

Upon entry of standard Weather Bureau data on wind direction, velocity and duration, this program will sort the data and accumulate the total number of hours the wind blows in any direction within a range of velocities as specified by the CAA for the construction of a standard "Wind Rose". For each category of direction and velocity this program will compute its frequency of occurrence as a percentage of the total number of hours of the period of record.

Input consists of a data tape composed of seven digit numbers coded to specify wind direction, velocity and duration. The data tape may be prepared on the G-15D or on a Flexowriter.

The output is a three-column tabulation of:

- a. code numbers specifying combinations of wind direction and velocity range
- b. the accumulated total number of hours the wind blows in any category specified by a. above
- c. the percentage of the total time the wind blows in any category specified by a. above.

The program as written will process any number of years of record and sort them into four categories of wind speed and sixteen directions.

The preparation of the data tape requires about 30 minutes per year of data to be processed. Running time is about 5 minutes per year of data processed.

USERS PROJECT NO. 336

AUXILIARY STATISTICAL ROUTINES

A. L. Squyres

July 3, 1959

ABSTRACT

This program operates on information left in the computer memory by the Multiple Regression Program (Users' Project #177), to compute additional information of interest in a statistical analysis of data. One routine types out regression coefficients together with their confidence limits to any specified degree of significance. The standard deviations and variance ratios for the regression are also typed. A second routine computes an analysis of variance, showing the variance attributable to any factor, its ratio to the error variance, and an indication of its significance level. A third routine uses data tapes prepared as input to the Multiple Regression Program to compute observed and predicted values of the responses, residuals, and percent differences.

COMPUTER AND ACCESSORIES: Bendix G-15D, no accessories.

PROGRAM LANGUAGE: Autopoint 24 (Machine Language).

RUNNING TIME: Limited by speed of type-out. For fifteen variables and four responses (maximum limits), total required time is 6 minutes for confidence limits, 6 minutes for analysis of variance, and 1.2 minutes per experiment for residuals.

COMMENTS: This program requires previous data processing with M.R.P. including input data tape preparation if residuals are desired. It is not necessary to have coefficients typed out by M.R.P.

Class 1

Title: DISCHARGE FOR TAINTER GATES WITH HORIZONTAL SILLS

Originator: Electronic Data Processing Branch

U. S. Army Engineer District, Los Angeles

Address: 751 S. Figueroa Street

Los Angeles 17, California

Mode: Intercom 1000, Double Precision

Date: March 1959

The program solves for discharge coefficients and the corresponding discharges for various gate openings and water surface elevations.

Input and output data are in fixed point decimal notation. Accuracy is dependent on input data. Data is carried in the computer to 12 places.

Formulae:

$$K_1 = N \left[1 - \sqrt{1 - \frac{(\phi - \frac{F1}{N})(2 - \frac{1}{N})}{NF2 - F3}} \right] \sqrt{\frac{2N - 1}{2N - 2}}$$

Where \emptyset = angle in radians of gate lip to horizontal

$$N = D/h F_1 = \frac{1 - \cos \phi}{\sin \phi} F_2 = 1 + \phi - \cos \phi$$

$$F_3 = \frac{1 - \cos \phi}{\sin \phi} + \frac{1}{2} \left(\frac{\phi}{\sin \phi} - \cos \phi \right)$$

$$C = 1.03 K_1 Q = Cbh \sqrt{2gH}$$

Formulae not applicable for values of N less than 1.5.

Input data consists of the gate height, width, and radius; height of pivot above floor, sill elevation, initial water surface elevation, maximum water surface elevation, increment in water surface elevation, initial gate opening and the increment in the gate opening.

The time required for the input of data is approximately 2 minutes per problem with input data verified for a visual check on accuracy. The time required for the solution of the modified discharge coefficient, head, and discharge for each water surface elevation is approximately 15 seconds. No auxiliary equipment is used.

ABS TRACT

for

Users' Project No. 338

Title: INTERCOM 1000 DOUBLE PRECISION MODIFICATION TO MAKE OP

61 REVERSE PAPER TAPE ONE BLOCK

Author: Den Secrest

The OP 61 command is used to start listing when the selective print routine has been read into the machine. If the 61 command is executed without the selective print routine in the machine a dynamic halt will occur. If the following corrections are made in the intercom 1000 double precision tape:

Change	06.61	from	vx3x0w6	to	3z3y0xz
	06.62		vy3y0w6		-2u2u2vz
	04.42		empty		2u2u39z
	04.43		empty		01012vz

the execution of an OP 61 command will reverse paper tape one block when the selective print routine is not in the machine. If the selective print routine is in the machine the 61 command will operate as described in the intercom manual.

Note if these corrections are made on the tape the new check sums must be recorded in the loader on line 04 and 06 must be rebalanced to the old check sum.

Users Project No: 339 Class: 1

Title: LERBS: PROPELLER PITCH CORRECTION

Originator: National Research Council of Canada

Mode: Intercom 1000 SP

Date: 15 July 1959

Abstract: Experience has shown that ship propellers designed from the theory of a moderately loaded propeller are underpitched. H.W. Lerbs derived an approximate correction to be applied to the theoretical values (ref. 1).

This program computes one of the terms in Lerbs' correction, viz.

$$a_{b_{0.7}} = 1/2 \sin \beta_{i_{0.7}} \sum_{0.7}^{L} (\frac{L}{D_{0.7}} \sin \mu - 0.7 \cos \beta_{i_{0.7}} \cos \mu) \int_{0.2}^{-L} \frac{G}{(P/R)^3} dx$$

where
$$(P/R)^3 = \left[x^2 + (L/D)_{0.7}^2 + 0.49 - 2(L/D_{0.7} \cos\mu \cos\beta_{i_{0.7}} + 0.7 \sin\mu)x\right]^{3/2}$$

For nomenclature used see Ref. 1.

The operator enters number of blades, L/D and β_1 appropriate to the 0.7 radius station, and values of G (non-dimensional circulation for a free-running propeller) at nine equidistant stations on the radius of the blade. The program outputs a table of values of P/R at each blade position, and the value of the correction factor $\alpha_{b_{0.7}}$.

Disclaimer:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Ref. 1. Lerbs, H.W., Propeller Pitch Correction Arising from Lifting Surface Effect". David Taylor Model Basin Report No. 942, Feb. 1955.

BENDIX USERS PROJECT NO: 340 CLASS: 1

TITLE: SOLUTION OF n SIMULTANEOUS ALGEBRAIC EQUATIONS WITH SYMMETRIC COEFFICIENTS.

ORIGINATOR: National Research Council of Canada, Ottawa.

MODE: Intercom. 1000 DP DATE: 23 July, 1959.

PROBLEM: Solve the set of equations represented by

$$\sum_{j=1}^{n} a_{ij} x_{j} = h_{i}$$

$$j = 1$$

$$(i = 1, 2, ..., n)$$

where the matrix (a_{ij}) is symmetric, $(i \cdot e \cdot a_{ij} = a_{ji})$.

RANGE: $n \leq 20$

METHOD: The equations are reduced to a triangular form and then solved by back substitution.

STORAGE LOCATIONS USED: The program occupies locations 1381, 1383 and 1400 to 1566. The diagonal coefficients are entered into locations 1300 to 1300 + 2(n-1). The non-diagonal coefficients are entered row after row beginning at location 0900. For n = 20, the last coefficient will be in location 1278. The hi values are entered into 1340 to 1340 + 2(n-1).

EXECUTION TIME:

n = 4, 50 seconds n = 20, 27 minutes

DISCLAIMER:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

USERS! PROJECT NO. 341

PROGRAM ABSTRACT

INVERSE BY VECTOR MATRIX MULTIPLICATION

Machine-Language Program

This procedure describes a program for finding the solution to successive sets of simultaneous equations by multiplying the inverse of the matrix of the coefficients by successive columns of constant terms (vectors). The maximum size of the inverse is 15 rows; the corresponding vectors must have 15 rows. As many vectors can be handled at one loading as there are rows in the inverse. Successive sets of vectors can be processed without reloading the inverse. The arithmetric is 12-digit, floating-decimal input and output. Vectors may be loaded via tape, typewriter, or card input. Type-in or card input errors can be corrected. This program uses S = 29 as a source of zeros. Inverse matrices in suitable form for this procedure may be obtained via Maisie, Users' Project No. 11.

Users' Project No. 342

PROGRAM ABSTRACT

Problem Statement:

Given x and y coordinates, solve for geographic positions (latitude or longitude); or given geographic positions, solve for plane coordinates (x and y).

Formula Used:

Formula as shown in Coast and Geodetic Publication #285.

It is necessary to change several constants depending upon the state and zone in which the desired coordinates are to be obtained. This program is based on the Lambert conformal conic projection.

User's Project No. 118 is used to solve for the constants of a Fourth Degree Polynomial which is used in solving for the latitude. This method has been used in several states and has proven quite satisfactory.

Mode:

Intercom 1000 DP

Running Time:

Five minutes for conversion from x and y coordinates to geographic coordinates. One minute for conversion from geographic positions to x and y coordinates.

JOB	No	

SHEET NO .__

ABSTRACT OF USERS

Project No. 343

Class 2

Title: Parcel Description from Station and Offset Data

Originator: Meissner Engineers, Inc.

300 West Washington Street

Chicago, Illinois

Mode: Intercom 1000D

Date: August 5, 1959

Description: Given an alignment on a tangent and/or a circular

curve, and given the station and offset of parcel corners; the program computes the length and bearing of each course, the coordinates of each corner, and the enclosed area. All input data is included

in the type-out.

Input is from the typewriter or flexowriter prepared

tape.

Computation and type-out time is approximately

thirty seconds per course.

Engineer	
DATE	

Title:

Ramp Terminals

Class:

2

Mode:

Intercom 1000 D.P.

Originator: Parsons, Brinckerhoff, Hall and Macdonald

Where a ramp leaves or enters a highway or where a major fork or merger occurs in a highway the vertex formed by the ramp and main line roadway or by the two roadways is called a bullnose or nose.

Given the pre-determined geometrics of the pavement edges or computed lines determining the basic alignment, and given the normal widths of roadways and ramps, with any required setback or flare or taper; this program locates the center of the bullnose, referenced to a coordinate system and the stationed lines of the two roadways, and produces values defining any flare, taper, or constriction.

The basic alignment of one roadway, for example - the main line, in the vicinity of the terminal, may be a tangent or a circular curve. The basic alignment of the other roadway, for example - a ramp, in the vicinity of the terminal, may be a tangent or a circular curve or may contain one P.C., P.T., or P.C.C.

Either or both roadways may have an increased or decreased width at the terminal point, and the resulting transition in width and pavement edge location may be accomplished either by a straight line tangent to the normal edge or by a single circular curve tangent to the normal edge. If the designer elects a curved transition edge, he also has the option of specifying either the transition curve radius or its length projection on the profile line. In all cases the transitioning edge is on the same side of the ramp or roadway as the bullnose.

Input consists of code numbers defining the basic type of alignment and options chosen, station and coordinate data for both roadways, curve data for one or both roadways (if any), normal offsets and changes in width for one or both roadways (if any) and lengths or radii of edge transitions.

The output items are the stationing of the bullnose along both roadways, the coordinates of the bullnose, stations of the start (or end) of the two transitions (if required) and the radii and central angles of transition curves (if required).

Title:

Earthwork Volumes and Mass Diagram

Class:

2

Mode:

Intercom 1000 24A

Originator: Parsons, Brinckerhoff, Hall & Macdonald

This program computes and tabulates the earthwork volumes between consecutive stations of a project, given the earthwork areas of each crosssection and any swelling or shrinkage factors. Volumes of earthwork are accumulated from the beginning of the project (or from any other starting point). If required, the program adjusts the volumes according to swelling or shrinkage factors applied to each individual item of earthwork and produces, for each point, its mass curve ordinates from a given datum.

The earthwork may consist of up to two items of excavation; i.e. rock and earth (or any two materials having different swelling or shrinkage factors), excavation of unsuitable material, and fill. Either the adjusting coefficients may be applied to each of the individual items of excavation, or an over-all shrinkage or swelling factor may be applied to the volumes of the embankment, or both embankment and excavation may be adjusted.

The computing of mass curve ordinates is optional. When called for, the ordinates of the mass curve at each point, consist of the algebraic sum of the accumulated adjusted earthwork volumes (cut +, fill -) added to the mass curve ordinate at the starting point. It is assumed that no unsuitable material is used in the construction of embankment, so these volumes are not included in the computations of the mass curve ordinates. Unadjusted volumes of the unsuitable material are produced in the output format. Adjusted volumes are only produced when the mass curve option is used. If no mass curve data are called for, the volumes produced are neat - without adjustment for shrinkage or swell.

The average end-area method of computing volumes is used.

The basic input consists of the starting mass curve ordinate (if any), various swelling and shrinkage factors, and the following data for as many stations as required: station of cross-section, cross-sectional area of cut material A, cross-sectional area of cut material B, crosssectional area of unsuitable cut material, and cross-sectional area of fill.

OUTPUT:

Option One:

STATION MASS CURVE ORDINATE

INCREMENTAL

ACCUMULATED

ROCK CUT ROCK CUT EARTH CUT MUCK FILL EARTH CUT MUCK FILL

NEAT VOLUME ADJ. VOLUME

Same as Option One but without mass curve ordinate and with only Option Two: one line of volumes (neat). -346Abstract of Users Project No. 346
Class 1

Title: DEGREES, MINUTES, AND SECONDS TO DECIMAL DEGREES AND VICE

VERSA

Originator: Richardson, Gordon and Associates

Address: Three Gateway Center, Pittsburgh 22, Pennsylvania

Mode: Intercom 1000 (Double Precision)

Date: August 19, 1959

This program converts an angle in degrees, minutes, and seconds to decimal degrees and an angle in decimal degrees to degrees, minutes, and seconds.

This method shows considerable advantages in speed and coding steps over other methods used to date. Coding requires less then one third of a line, and the time of conversion is less than 2-1/2 seconds.

ABSTRACT FOR USERS PROJECT NO. 347

Class 2

Title: EIGEN VALUES AND EIGENVECTORS

Originator: Railway Technical Research Institute

Address: No. 1, 1-chome, Shibakaigandori;

Minato-ku, Tokyo, Japan

Mode: Intercom 103

Date: September 9, 1959

This problem computes the eigen values and eigenvectors of a real symmetric matrix of the order up to and including 18 through Intercom 103 according to the rotational, i.e. Jacobie's method. It takes about n⁴ seconds to compute the eigen values and eigenvectors of an n-th order real symmetric matrix.

As is well know, it computes also the determinant and the inverse of a matrix of the same type, and therefore solves the linear simultaneous equations with an additional routine of matrix multiplication.

Abstract of Users' Project No 348

Class 1

Title: Bridge Pier Analysis Originator: Reynolds, Smith & Hills

Architects and Engineers

Address: 227 Park Street, Jacksonville, Fla.

Mode: Intercom 1000 (S.P.) 1 September 1959 Date:

This program calculates live load girder reactions from the superstructure of a simple-span bridge, combines these reactions with dead load and wind for various combinations as specified during input, applies these loads successively to the frame and types out final end moments, shears, and column reactions for each combination. Ordinates for plotting curves of maximum moment and shears across the cap beam are computed and typed for each point where vertical load is applied and at the column faces.

During input up to seven different locations of possible live load lane positions may be specified. Later, the beam reactions for any number of these positions may be accumulated and combined with dead load and wind to form the desired loading conditions for the pier. Up to 8 different loading combinations may be processed in one run. Equations for the Slope Deflection analysis are generated and solved for all 8 combinations simultaneously. The end moments shears and column reactions for each combination are typed. All calculations are in accordance with AASHO Specifications, where applicable.

The pier may have from 2 to 6 columns which may be round or rectangular. All members are prismatic and the columns must be fixed at their lower ends. Up to 29 beams may be located on each side of the pier and may be arranged in any desired spacing. Any of the AASHO live loads may be specified.

The modifications to accommodate varying numbers of columns, loadings, etc., are all made automatically so that input is similar for all situations. No special setup codes or flags are needed before computation starts.

Referring to AASHO Sec. 1.4.1, only Group I, II and III loadings are considered. Loads are distributed to the girders by the slab which is assumed to function as a series of simple spans between the girders. No impact is included. Reduction factors for multiple lanes of live load are automatically applied. If a load combination includes wind the answers for that combination are multiplied by .8 to compensate for higher allowable stresses.

Input is scattered throughout computation and is complete about halfway through the solution. Program tape is read at three different times during computation. All intermediate results of computation are stored as required except the actual girder reactions for each load combination. These are punched for subsequent read in. However this punching is buffered so as not to interfere with computations.

No auxiliary equipment is required.

Typical operating times:

- 1. 2 cols; 7 girders, 4 lane positions, 8 combinations
- 2. 3 cols; 10 girders, 6 lane positions, 7 combinations = 1 hr. 11 mins.
 3. 6 cols; 13 girders, 7 lane positions, 8 combinations = 1 hr. 50 mins.

Title: MODIFIED BESSEL FUNCTIONS OF THE SECOND KIND

Originator: National Research Council of Canada, Ottawa.

Mode: Intercom 1000 D.P.

Date: 11 August, 1959

Problem: Compute the Modified Bessel Function of the Second

Kind, $K_n(z)$, where

 $K_n(z) = i^{n+1} \frac{\pi}{2} \left[J_n(iz) + i Y_n(iz) \right]$

and where $J_n(iz)$ and $Y_n(iz)$ are ordinary Bessel functions of the first and second kind.

Range: n to be an integer or half-integer. z to be greater than zero.

Entry: Place |n| in address 1100, and z in the accumulator.

Execute a "mark place and transfer" to address 1300.

(i.e. command "026 1300")

Exit: $K_n(z)$ is left in accumulator, |n| in 1100, z in 1102, control is returned to marked place.

Accuracy: At least nine digits.

Error Stops: If z = 0 is entered, an overflow will occur.

Method: Evaluation of series.

Execution Time: Depends on n and z. Average time is about two minutes.

Storage Locations Used: All the memory is used except 1744 to 1799 and channel 18.

Note: With a change of one command the program can be used to calculate Bessel functions of the first kind, $I_0(z)$ and $I_1(z)$.

Disclaimer:

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DAISY 201 Appendix No. 053 - Read MAP-29 Tape

Abstract

This appendix supplies DAISY OP-codes for skipping or reversing one block of tape, and for reading a block of tape with or without type-back of floating decimal numbers. These instructions require specification of the index register used to store the numbers from the A-register (where they are placed, one at a time, by the appendix routing); this index register also serves to signal the end of a block to the appendix routine.

USERS! PROJECT NO. 351

ABSTRACT

$$J_o(x)$$
, $J_1(x)$, $Y_o(x)$ and $Y_1(x)$

This subroutine may be used with SADIE to calculate the above-mentioned Bessel Functions for any value of x. (If the Y functions are not needed, a shorter program is available for calculating only the J functions).

Locations 500 through 663 and Index Registers 8 and 9 are used. Appendix Sub-Routine #003 must be in Appendix Line 0, and Sub-Routine #001 must be in Appendix Line 1.

USERS! PROJECT NO. 352

ABSTRACT

 $J_0(x)$ and $J_1(x)$

This subroutine may be used with SADIE to calculate the Bessel Functions $J_0(\mathbf{x})$ and $J_1(\mathbf{x})$ for any value of \mathbf{x}_\bullet

Locations 500 through 599 and Index Register 9 are used. Appendix Sub-Routine #003 must be in Appendix Line 0.

Title:

STRINGER LAYOUT FOR BRIDGE ON SPIRAL

Class:

2

Mode:

Intercom 1000 D.P.

Originator:

Tippetts-Abbett-McCarthy-Stratton

Date:

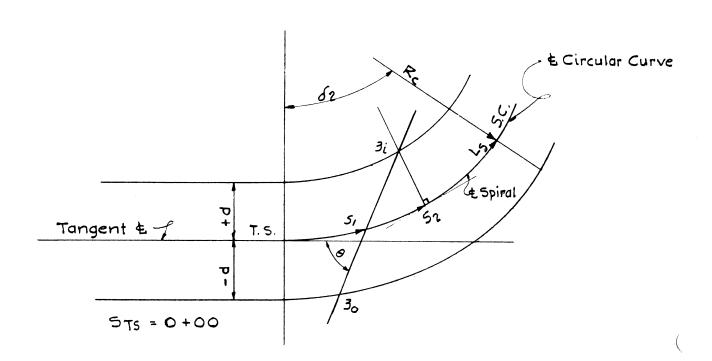
September 16, 1959

This program, consisting of three optional parts, computes the length of a pier skewed to the centerline of a spiralled roadway, giving stations from the T.S. and coordinates of the intersection of the centerline of pier and the edges of pavement; stations, coordinates and offsets from the spiral centerline of the intersection of ten stringers with the centerline of pier; and offsets from the tangent to points at 25 foot increments along the spiral.

INPUT DATA: Length of spiral, radius of circular curve, distance along spiral from T.S. to intersection of centerline of pier and spiral centerline, angle between centerline of pier and tangent to the curve at the T.S., and radial distance from centerline of roadway to either edge of roadway.

OUTPUT: Output sheets for the three options of the program have been designed to a standardized format for ease of designers interpretation.

NOTE: Although the program was written for ten stringer locations, this number may be increased by repeated runnings of the program.



Title:

BEAMS ON ELASTIC FOUNDATIONS

Class:

2

Mode:

Intercom 1000 and 101

Originator:

Tippetts-Abbett-McCarthy-Stratton

Date:

September 16, 1959

This program is in two parts which can be run independently. It is designed to calculate foundation pressure and shears and moments as described below.

PART I

This Part determines the elastic foundation pressure at eleven equi-distant points (i.e. the ends and the tenth points) under a beam of uniform cross-section. The term "elastic foundation" assumes that the settlement at any point is proportional to the pressure at that point, but the proportionality constant (the foundation modulus k₁, defined as the settlement per unit pressure) may vary in value along the length of the beam. The assumption is also made that the foundation modulus in tension is equal to that in compression.

INPUT DATA: Length, moment of inertia, elastic modulus of beam, foundation moduli of supporting material at the tenth points and the external loading, which can be a uniform load along the whole span, plus a maximum of 20 concentrated loads and 20 applied moments.

METHOD OF SOLUTION: The method of solution is essentially that of treating the foundation pressures as a series of redundant reactions and solving for the statically indeterminate system by equating deflections. It is based on an ASCE paper (No. 2362) by Mr. Z. Levinton.

OUTPUT: The matrix of coefficients of the simultaneous equations is typed out in fixed point and the foundation pressures in floating point.

PART II

This Part determines the shears and moments at the eleven points above as well as at any point where a concentrated load and/or an external moment is applied. Where a concentrated load is applied, the shears to the right and left of the point and the moment at the point are computed; where an external moment is applied, the moments to the right and left of the point are computed. Thus, complete information for plotting the shearing force and bending moment diagrams will be made available.

INPUT DATA: The input data are the externally applied loads and moments, plus the eleven foundation pressures derived in Part I.

METHOD OF SOLUTION: The method of computation utilizes the basic Statics principles of summation of shears and moments.

OUTPUT: The shears and moments are typed out in fixed point.

Abstract of U.P. No. 355 Class 2

Title:

Storm Drainage System Design

Originator:

Parsons, Brinckerhoff, Hall & Macdonald

Address:

165 Broadway, New York 6, N. Y.

Mode:

Intercom 1000 S.P. - No Auxiliary Equipment

Date:

September, 1959

Program Scope: This program can design a storm drainage system of up to a maximum of 50 segments consisting of mains, branches and laterals in any combination. For each segment the program first determines the quantity of flow the segment is expected to carry using the Rational Method of predicting runoff. The program then selects a standard pipe size to carry the flow at a slope set by the designer. An alternate design is also produced using the next smallest pipe size set at a steeper grade. Finally, the program computes various hydraulic characteristics of the flow through the segment. The designer may set maximum and minimum diameters and maximum and minimum velocities to control the selection of pipe sizes.

Method of Computation: The program uses the Rational Method of predicting runoff. Code numbers are assigned to each segment to identify initial inlets and the number of branches entering a junction. Two runoff coefficients are assumed to apply over the entire system and two areas, corresponding to the two coefficients, are entered for each inlet. Once the time of concentration is found, the corresponding intensity of rainfall is gotten either by solving an equation or by interpolating between values scaled from a rainfall graph. The pipe diameter is computed using Manning's Formula and is rounded to the next standard size.

Program Limitations: (1) The velocity used in computing time of concentration is that of the standard pipe flowing full; the velocity checked against minimum and maximum velocity criteria is that of the theoretical pipe diameter flowing full. (2) The system must be made up of circular pipes only. (3) No pumping or ponding is permitted. (4) No invert elevations are produced. (5) Energy losses at catch basins and inlets are ignored.

Operating Times: Average about 1-1/2 minutes per pipe segment for type-in, computation and type-out.

USERS PROJECT NO. 356

Abstract

A subroutine to be used in conjunction with the latest Intercom 1000, whose loader has a check sum equal to .3121959, to reverse tape. Tape is reversed the number of blocks specified in b_n . It is in machine language with entry at 00 and exits into Intercom. It is operated out of line 05 by making use of the operation code 02.

ABSTRACT OF USERS PROJECT NO. 357 CLASS 2

TITLE: Lagrange Interpolation (5 points)

Originator: The Fellows Gear Shaper Co.

Address: 78 River St., Springfield, Vermont

Mode: Daisy (Intercom 201)
Date: September 9, 1959

This program will interpolate a set of given values X and Y where the given values of the independent variable may or may not be at even intervals. The following Lagrange formula is used taken from the book "Numerical Mathematical Analysis" by James B. Scarborough. Chapter IV.

5 Point Interpolation.

$$\begin{array}{l} y_{1} = \frac{\left(x_{1} - x_{1}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{3}\right) \left(x_{1} - x_{4}\right)}{\left(x_{0} - x_{1}\right) \left(x_{0} - x_{2}\right) \left(x_{0} - x_{3}\right) \left(x_{0} - x_{4}\right)} \times & y_{0} \\ \\ + \frac{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{3}\right) \left(x_{1} - x_{4}\right)}{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{3}\right) \left(x_{1} - x_{4}\right)} \times & y_{1} \\ \\ + \frac{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{1}\right) \left(x_{1} - x_{3}\right) \left(x_{1} - x_{4}\right)}{\left(x_{2} - x_{0}\right) \left(x_{2} - x_{1}\right) \left(x_{2} - x_{3}\right) \left(x_{2} - x_{4}\right)} \times & y_{2} \\ \\ + \frac{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{1}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{4}\right)}{\left(x_{3} - x_{0}\right) \left(x_{3} - x_{1}\right) \left(x_{3} - x_{2}\right) \left(x_{3} - x_{4}\right)} \times & y_{3} \\ \\ + \frac{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{1}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{3}\right)}{\left(x_{1} - x_{0}\right) \left(x_{1} - x_{1}\right) \left(x_{1} - x_{2}\right) \left(x_{1} - x_{3}\right)} \times & y_{4} \\ \\ \end{array}$$

$$\text{Where } \frac{x_{3} + x_{2}}{x_{3}} \times x_{1} \times x_{1} \times x_{2} \times x_{1} \times x_{2} \times x_{2} \times x_{1} \times x_{2} \times x_{3} \times x_{3} \times x_{4} \times x_{3} \times x_{4} \times x_{4}$$

The input values X and Y are previously punched on paper tape in Daisy floating point notation in blocks of 100 input words each. Additional blocks of input information are automatically read as required while the program is in operation.

The interpolated values $X_{\dot{1}}$ and $Y_{\dot{1}}$ are typed out in a two column format in fixed point decimal notation.

Operation time is 15 seconds for each interpolated value of X, and Y, if a new set of values X and Y does not have to be used in the above formula, and 35 seconds for each new X and Y used.

PALMER & BAKER ENGINEERS, INC.

DESIGN COMPUTATIONS

SHEET NO

MADE BYCharlton DATE 9-3-59

SUBJECT MATTER PROGRAM FOR BENDIX G-15D COMPUTER

CHECKED BY.

Abstract of Users Project No. 358

Class

2

TRAVERSE COMPUTATIONS Title:

Mode: Originator: Address:

Intercom 1000D (August 1958) Palmer & Baker Engineers, Inc. P. O. Box 346, Mobile, Alabama September 3, 1959

Date:

Input consists of initial bearing, initial coordinates, final coordinates, final bearing, a deflection angle for each point and distances between points for a limit of forty points.

The first part of the output consists of initial bearing, initial coordinates, adjusted angles and unadjusted coordinates for each point; adjusted bearings and unadjusted distances between the points; and errors of closure.

The second part of the output consists of adjusted values of bearings, coordinates, deflection angles, and distances with the area enclosed by the traverse.

The angular error of closure is distributed evenly to all angles requiring adjustment. Coordinates are adjusted by application of the Compass Rule, and adjusted distances are obtained from adjusted coordinates.

Angles which are not adjusted are angles with given values of zero and 180, and angles selected by the user. In addition, the user may select distances which will not be adjusted.

The projection of adjusted angles and distances will not always produce the adjusted coordinates as the methods of adjustment follow those given in American Society of Civil Engineering Manual of Engineering Practice, Manual No. 20: Horizontal Control Surveys to Supplement the Fundamental Net.

The program will also compute traverses with one side and angle missing and open-end traverses, but makes no adjustment. There is no type out of trigonometric functions, latitudes or departures.

Subroutines used: square root; sin, cos; fraction selector

Auxiliary equipment used: none

Computation time: varies

Abstract and Program Description of Users Project No. 359
Class 1

Title: INDEX REGISTER SUB ROUTINE

Originator: Pomona College, Mathematics Department

Address: Claremont, California

Mode: Intercom SP.

Date: September 23, 1959

- 1. Purpose of sub routine: To increase the versitility in the use of index registers when programming the G-15 using intercom 1000.
- 2. Functions of the sub routine:
 - a. To replace the contents of any index register by any other.
 - b. To enable the word base to be decreased by the word difference.
 - c. To enable the word limit to be decreased or increased by the word difference in any index register.
- 3. Loading the sub routine:
 The sub routine may be loaded into any available channel by typing "55CHOO tab s" where CH is the desired channel.
- 4. Programming using the sub routine: In using the sub routine there are 4 parts to the command. The command is of the form 08 CH LK:
 - 08 is the standard code for performing a sub routine.
 - CH is the channel in which the routine is stored.
 - L indicates the operation to be performed from the table below.
 - K is the index register affected.
 - L Operation
 - O The contents of index register 1 will be replaced by index register K.
 - 1 The contents of index register K will be replaced by index register 1.
 - 2 The word base in index register K will be decreased by the word difference.
 - 3 The word limit in index register K will be increased by the word difference.
 - 4 The word limit in index register K will be decreased by the word difference.
- 5. Error indication:

If through the use of this sub routine, either the word base, or the wor limit is given a negative value, the computer will return to the manual mode.

Abstract of Users Project No. 360 Class 2

Title? PARTIAL FRACTION EXPANSION PROGRAM

Originator? Pomona College Mathematics Department

Address: Claremont, California

Mode? Intercom (SP) and Machine Language

Date: September 23, 1959

Statement of problem: Given an expression of the form:

$$\frac{P(x)}{\sqrt{(x+a_i+jb_i)}}$$
, find the values of A_i such that

this expression is equal to
$$\sum_{i=1}^{q} \frac{A_i}{(x + a_i + jb_i)^m}$$
.

Where m is equal to or less than the multiplicity of the root and q is the degree of the denominator.

The denominator must be of degree 49 or less, and the numerator of smaller degree than the denominator. The values of the coefficients of $P_{(x)}$ and of a and b are entered into the computer in floating point notation from the typewriter under control of the program.

The output gives the complex value of A_i, the complex value of the denominator of the term and indicates the power of the denominator.

The operating times depend upon the degrees of the polynomials, and the number of multiple roots. A quadratic divided by a quartic with a single double root takes about five minutes.

No auxilliary equipment is used.

Abstract of Users Project No. 361

Class 2

Title: PLATE GIRDER FLANGE PROPERTIES TABLE GENERATION

Originator: Richardson, Gordon and Associates

Address: 3 Gateway Center, Pittsburgh 22, Penna.

Mode: Intercom 1000 Single Precision

Date: October 1, 1959

Given the detailed dimensions of a built-up girder flange consisting of angles and a cover plate, this program will generate a table of design gross and net properties for a varying cover plate thickness.

The program is written to handle built-up girder flanges with up to four rivet holes in the out standing legs and two rivet holes in the vertical legs. The program will handle any of the normal rolled angles and coverplate thicknesses.

Input basically consists of coverplate width and the limits of the range of coverplate thickness to be computed; angle width, depth, and thickness; dimensions governing location of rivet holes; and the rivet size.

The output format is shown in the write-up. The type out gives the coverplate thickness, flange area, location of centroidal axis and the moment of inertia about this axis for both gross and net sections. Also, the unit gross weight for two flanges is typed out.

The parallel axis theorem was used to find the mement of inertia about the centroidal axis.

Computational and output time runs approximately 25 minutes for a table with coverplate thicknesses varying from 0 inches to 3 inches in sixteenth inch increments.

Abstract of Users Project No. 362

Class 2

Title:

FOURIER SYNTHESIS

Originator:

Pacific Union College Data Processing Laboratory

Address:

Angwin, California

Mode:

Machine Language (S. P.)

Date:

June 1, 1959

This program will compute a table of values of the Fourier Series:

 $F(\theta) = K(a_0/2 + a_1 \cos \theta + b_1 \sin \theta + a_2 \cos 2\theta + b_2 \sin 2\theta + ...)$

The first value computed will be $F(\theta_0)$ and then θ will be incremented until $\theta > 2\pi$. Up to 52 sine and 52 cosine terms may be used.

Required imput is: a starting angle θ_0 , θ increment size, the number of the highest order term, a constant multiplier, and the coefficients of all terms computed.

The output consists of two columns; the angle in radians versus the value of the series at that point.

Operating time is approximately 1/2 second per term per point (computation continues during typeout).

DE LEUW. CATHER & COMPANY

ENGINEERS

OKLAHOMA CITY CHICAGO NEW YORK BOSTON TORONTO

150 NORTH WACKER DRIVE CHICAGO 6, ILLINOIS

FINANCIAL 6-0424

USERS! PROJECT NO. 363

ABSTRACT

TITLE:

Stringer Geometrics and Elevations for Bridge

on Circular Curve

CLASS:

MODE:

Intercom 1000 Double

ORIGINATOR:

De Leuw. Cather & Company

DATE:

September 1, 1959

PROBLEM STATEMENT:

The program computes the stationings, offsets from the centerline of the roadway, and top of roadway elevations of the stringers at centerline of piers and centerline of bearings; at division points of each stringer from centerline to centerline of piers or bearings; and for curved lines and division points of each curve from centerline to centerline of piers. Seven types of cross-sections are included. These consist of symmetrical and unsymmetrical straight superelevation, symmetrical and unsymmetrical linear transition from one superelevation to another, three different superelevations, tangent crown and linear transition from superelevation to tangent crown. Piers and stringers may be non-parallel. Curves must be concentric with centerline of roadway. Entire span must be on curve. Arc definition is used.

INPUT DATA:

Horizontal control data.

Radial dimensions of concentric curves. Stringer spacings along centerlines of piers.

Vertical profile data.

OUTPUT:

Stationings, offsets from centerline of roadway and top of roadway elevations for the following:

- 1. Intersections of stringers with centerlines of piers.
- 2. Intersections of stringers with centerlines of bearings, if any.
- 3. Intersections of concentric curves with centerlines of piers, if any; and division points for each curve.
- 4. Angles and lengths, and division points for each girder, if any.

Class

1

Title: PEEK (Program Explorer Editor Keeper)

Originator: Tudor Engineering Company

Address: 595 Mission Street, San Francisco 5, Calif.

Mode: Machine Language (S.P.)

Date: July, 1959

This program allows inspection and modification of any location, including all registers and short lines. It also restores all locations to their original values except the AR format which is changed to the standard format, and the return command in the conversion subroutines.

The program occupies lines 02 and 04, and it is meant to be included as a part of machine language programs. It contains a modified conversion routine in line 02. All scaling is as fractions.

The program allows decimal or hex type out and permits the entry of hex, decimal, and decimal commands. It will also insert or remove breakpoints.

It will not read out a command in decimal form; however, the hex equivalent is type out after insertion of a decimal command. All entries are type back in either decimal or hex form.

This program was developed to allow rapid "debugging" by the breakpoint - inspection method, and to allow modifications and data entry to completed program. With this program it is possible to stop a program at any point, inspect or modify any location, then proceed with the program from the point stopped with everything restored.

Title: SWEDISH SLIP CIRCLE ANALYSIS

Class: 2

Mode: Machine Language (S.P.)

Originator: Tudor Engineering Company

595 Mission Street, San Francisco 5, California

Date: September 1959

Given the basic soil data at a given site and the location and radius of a desired circle, this program computes the safety factor and driving and resisting forces by the classic Swedish Slip Circle Analysis, using the slice method.

The different soil surfaces are defined by "x" and "y" coordinates and the soil properties under these surfaces by densities, cohesion and the tangent of the angle of friction. The maximum number of different soils is limited to 20. The number of points in any one surface is only limited by a maximum of 107 points for one site. A fairly complex earth structure, such as an earth filled dam, can easily be handled. This basic site data can be prepared on the computer or on a Flexowriter or data punch.

The individual circle data is typed in and each circle is computed and the results typed out. A search routine is provided to determine the critical circle.

The program will, if required, compute the **effects** of earthquake forces. A separate soil density is used for this, and the forces can be computed at the mid-height of the material or at the base of the slice. The effect on the normal force can be included or not as desired.

Two methods of approximating the seepage forces are included. In either case, two density values are provided for each material. In the first method, one density is used for the normal force. On the second method, the first density is used for both the tangential and normal forces on the driving side of the circle. The other density is used on the resisting side of the circle.

For an average circle of about eight materials and 15 slices, the operating time is about one to one and one-half minutes per circle.

Title: ARITHMETIC INTEGRATION OF SIMPLE SURGE TANK

Class:

7

Mode:

Machine Language

Originator:

Tippetts-Abbett-McCarthy-Stratton

Date:

November 1, 1959

This program performs the arithmetic integration required to determine the height of surge and check the stability of a simple surge tank of predetermined cross-sectional area.

The input consists of the following quantities:

- a. Initial "steady state" flow through conduit before any load change.
- b. Initial "steady state" water level in surge tank.
- c. Flow through turbine after load change.
- d. A coefficient which when multiplied by the velocity head represents the instantaneous friction and miscellaneous losses in the conduit.
- e. The length of conduit between intake and surge tank.
- f. The cross-sectional area of surge tank.
- g. The cross-sectional area of conduit.

The output is a four-column tabulation of:

- a. Elapsed time from the instant of load change.
- b. Flow through the conduit at the elapsed time.
- c. Water level in the surge tank at the elapsed time.
- d. Velocity of flow through the conduit at the elapsed time.

The above information will be computed for a one second time interval and typedout for every fifth second computed and at times when the water level in the surge tank is at a maximum or minimum.

The program assumes instantaneous gate operation in response to a sudden change of load requirements.

Output proceeds at a rate of 50 seconds elapsed time per minute of operation.

Abstract of Users' Project No. 367

Class 2

Title: REPORT INDEX SEARCH - TAPE JUSTIFICATION

Originator: E.I. du Pont de Nemours & Company, Incorporated

Address: Centre Road Building, Wilmington 98, Delaware

Mode: Machine Language

Date: September 25, 1959

This routine provides a word-by-word comparison between two alphanumeric punched tapes, with the preparation of a single verified tape. This final tape is a duplicate of the originals if they are identical. If the two tapes being compared are different, one line from each is typed out, and the operator may select the correct one or insert a corrected line, as may be required.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours & Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Class 2

Title: REPORT INDEX SEARCH - FILE PREPARATION

Originator: E.I. du Pont de Nemours & Company, Incorporated

Address: Centre Road Building, Wilmington 98, Delaware

Mode: Machine Language

Date: September 25, 1959

For efficient searching of the Subject Index to Research Reports, it is necessary to perform the following steps in converting the justified file from the format on the McBee cards to that used on magnetic tape:

- 1. All codes associated with one report number must be collected into a single block, and duplicate codes must be eliminated.
- 2. The subject codes associated with each report number must be arranged in order of increasing numerical value.
- 3. Each subject code except the smallest for each report must be replaced by the difference between it and the next smaller one.
- 4. Shift characters must be inserted in the report code to provide the desired appearance for output purposes.
- 5. A single block must be made up, containing from 1-100 subject words, a report number and a check sum.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours & Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Abstract of Users' Project No. 369

Title: REPORT INDEX SEARCH - QUESTION ANALYSER

Originator: E.I. du Pont de Nemours & Company, Incorporated

Address: Centre Road Building, Wilmington 98, Delaware

Mode: Machine Language

Date: September 25, 1959

In order to make an effective comparison between the list of subject codes being searched for (the question list) and the list of subject codes related to a report (the disclosure list), it is necessary to place both lists in the same format. This routine analyzes the composite questions being asked and transforms them into the form required for the sake of efficiency by the searching routine (ES-15). It also prepares the necessary labels for the search output.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours and Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Abstract of Users' Project No.370

Class

2

Title: REPORT INDEX SEARCH - FILE SEARCHING ROUTINE

Originator: E.I. du Pont de Nemours & Company, Incorporated

Address: Centre Road Building, Wilmington 98, Delaware

Mode: Machine Language

Date: September 25, 1959

In designing the index searching system of which this routine is the final step, an attempt has been made to make the serial searching of the report index as efficient as possible on a magnetic drum computer. Accordingly, the file preparation and question analysis routines (ES-13 and ES-14) have done all of the preliminary ordering and differencing of the index and question. The search routine therefore has only to carry out a series of rather simple comparisons, which it does rather efficiently, and to assemble the output reflecting the results of these comparisons, which it does rather inefficiently.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours & Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Abstract of Users' Project No. 371
Class 2

Title:

REPORT INDEX SEARCH - FILE CORRECTION AND

UP-DATING ROUTINE

Originator:

E.I. du Pont de Nemours & Company, Incorporated

Address:

Centre Road Building, Wilmington 98, Delaware

Mode:

Machine Language

Date:

September 25, 1959

This routine provides a manually-controlled selective merging of two or more report index files to produce a single up-dated file on magnetic tape. The input files are on paper and/or magnetic tape, in standard G-15 hexadecimal code. Control is exercised and monitoring information is typed out via the AN-1 controlled Flexowriter.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours & Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Abstract of Users' Project No. 372

Class 2

Title: REPORT INDEX SEARCH - SERVICE ROUTINES

Originator: E.I. du Pont de Nemours & Company, Incorporated

Address: Centre Road Building, Wilmington 98, Delaware

Mode: Machine Language

Date: September 25, 1959

These routines have been written as needed to perform various chores of use during preparation, correction, and handling of the tapes used by this system. They are a motley collection of varied history, which are preserved mainly for the convenience of non-programmers who may be faced by the necessity of listing or copying portions of the report index file.

These routines are submitted to the Bendix Computer Users' Organization for distribution to all participating members by the Textile Fibers Department, E.I. du Pont de Nemours & Company, Incorporated, Wilmington 98, Delaware. Inquiries and comments should be directed to Dr. J. D. Grandine, 2nd.

Title: COMPLEX ERROR FUNCTION AND COMPLEX ERROR INTEGRAL Originator: National Research Council of Canada, Ottawa

Mode: Intercom 1000 D.P. Date: October 7, 1959

Given a complex variable, z = x + iy, calculate Abstract:

the complex error function

erfi (x) =
$$\int_{0}^{x} e^{t^2} dt$$

and the complex error integral

$$w(z) = u + iv = e^{-z^2} (1 + \frac{2i}{\sqrt{w}} \int_0^z e^{t^2} dt)$$

The method used is that of Ref. 1.

 $0 \le x \le 5$, $0 \le y \le 1$

For erfi(x), store x in 1600 and execute a "marked place and transfer I "to address 1215 ("0 26 1215"). For w(z), store x in 1600, y in 1602, and execute a transfer to 1220 ("0 26 1220"). Input:

Output: Erfi(x) is stored in 1660 in both cases. u is stored in 1620 and v in 1622 in the second case. Control is returned to the marked place in both

Accuracy: Not known, but at least six decimal places. Depends on x and y, but is roughly one to two minutes. The calculation time Execution time: of erfi(x) is about half that of w(z).

Faddeeva, B.H., and Terentiv, H.M., Tables of Values of the Error Integral for complex arguments, Ref. 1: Gosudarstv. Izdat, Tehn. Teor. Lit., Moscow 1954 (in Russian). See also Carslaw, H.S., and Jaeger, J.C., Conduction of Heat in Solids, Oxford Univ. Press, 2nd Edit.,

1959, p. 484 et seq.

Disclaimer:

No responsibility is assumed by National Research Council of Canada for any errors or misrepresentations that may occur as the result of using this program. No responsibility is assumed by the Bendix Computer Division for the correct reproduction of this program.

Abstract of Users' Project No. 374 Class 2

Title: Gamma Function Subroutine (Intercom 1000 D)

Originator: Pioneering Research Division Textile Fibers Department

E. I. du Pont de Nemours & Co., Inc.

Mode:

Wilmington 98, Delaware Intercom 1000 Double Precision

Date: October 15, 1959

This is a channel 13 subroutine in Intercom 1000 coding (not an appendix subroutine) which computes gamma functions of any numbers or factorials of integers. The integral portion of the input number may not exceed 34 since higher numbers exceed the capacity of the computer.

Abstract of Users' Project No. 375 Class

Title: Intercom 1000 D Fixed-Point Output Subroutine

Originator: Pioneering Research Division

Textile Fibers Department E. I. du Pont de Nemours & Co., Inc.

Mode:

Wilmington 98, Delaware Intercom 1000 D (Appendix Subroutine)

September 21, 1959 Date:

Appendix Subroutine number 1 (Format Selector) is very limited in the number of formats available. This subroutine increases the number of formats for fixed-point output, at the same time making it possible to place the minus sign next to the first digit of output.

From 1 to 12 digits of numbers may be typed, with the decimal point in any location; e.g., you may type fixed-point numbers as small as

 1×10^{-12}

up to numbers as large as

 $(0.999.999.999.999) \times 10^{12}$.

The number to be typed must be in the A-register. Two successive commands are then required. The first specifies the channel and word number of entry to the subroutine, as usual. The second specifies the number of digits before and after the decimal point for output. Entry words are:

> 00 Type

01Type and Tab

02 Type and Carriage return

If the number is too large for the format specified, it will be typed in floating-point followed by a carriage return.

Both Appendix I and Appendix II tape versions of the subroutine are available.

Class 1

TITLE: FIT ANALYSIS BY LEAST SQUARES (FABLES)

(Rewrite of Users Project No. 138)

ORIGINATOR: U.S. ARMY ARTILLERY AND MISSILE SCHOOL

Department of Gunnery

Research and Review Division

Fort Sill, Oklahoma

MODE: INTERCOM 1000 (SP) or INTERCOM 500

DATE: 20 October, 1959

Given a set of paired numbers of two related variables which have been obtained by measurement, counting or some such method of observation, this program finds a curve having the property that the sum of the squares of the deviations of the observed points from the fitted curve will be a minimum. The types of curves employed for fitting are straight lines, quadratic, exponential, logarithmic and power function curves.

The program allows any one or all of the above functions to be tried. The output includes the constants for each type of curve and the standard deviation. By comparing the standard deviations, the curve which best fits the data can be obtained.

Data can be entered from the keyboard or from paper tape prepared on either the Flexowriter or the Bendix computer. Using INTERCOM 1000 (SP), a maximum of 50 sets of data can be used at one time. This may be expanded to a maximum of 200. By using INTERCOM 500, 150 sets of data can be handled, and up to 200 sets if the loader is destroyed in memory. In all cases output will be via the keyboard.

An ANNEX has also been written which utilizes the output of the program and selected values of the independent variable to determine the dependent variable along the curve selected. Again input can be from the keyboard or from paper tape prepared on the Flexowriter or the computer.

Running time varies with the number of points given and whether all or only one solution is desired. For a program using 40 sets of data and all solutions, approximately 25 minutes are required after data is entered. The ANNEX gives solutions approximately every 10 seconds after data is entered.

FIT ANALYSIS OF LEAST SQUARES (501 FABLES) Title:

Modification of Users Project No. 376

Douglas Aircraft Company, Inc. Originator:

Address: 3000 Ocean Park Blvd., Santa Monica, California

Prepared by: A. W. England, Dept. A-852

Mode: Intercom 500 or 501

Date: 2 June 1960

Given a set of up to 200 points, X and Y values, this program will fit any one or all of five types of mathematical functions to these points by the method of least squares. It will also compute the standard deviations as a criterion for quality of fit. If desired, the program will evaluate the function at the input points and give the difference between the given and fitted Y. The five functions available are:

> $Y = A_o + A_1 X$ $Y = A_o + A_1 X + A_2 X^2$ $Y = A_o e^{A_1 X}$ 1. Linear Function 2. Quadratic Function

3. Exponential Function

 $Y = A_0 + A_1 \ln X$ 4. Logarithmic Function

 $Y = A_{\Omega} X^{A_1}$ 5. Power Function

Input consists of a set of points entered manually (either from typewriter or tape) and then under program control, the number of points, the type of function to be fitted, and a flag for input point evaluation.

Output consists of an identifying function number, the coefficients of the equation of best fit, and the standard deviation. If evaluation has been indicated, this is typed out below the coefficients in four columns: Given X, Given Y, Computed Y, and Difference.

There is an appendix available which will evaluate any of the five functions at either a specific number of points or over a specified range at given intervals.

Input consists of either the specific X values or else the starting value, increment, and final value for a range of points. The function number and coefficients will be typed out followed by two columns of X and Y values.

The appendix also has routines for changing the output form from fixed to floating point, and vice versa.

The program running time will depend on the number of input points, type of function, and evaluation flag.

Since the input of data is controlled from the manual mode, it is possible to use any of the applicable auxiliary input devices such as flexowriter prepared tape, magnetic tape, etc., by simply entering the necessary subroutines from the Intercom tape into either an unused data channel or program channel before the program is entered and calling for input step by step manually.

Abstract of Users' Project No. 377 Class 1

Title: Decimal to Binary Conversion and Sum of Entire Line

Originator: Vogt, Ivers, Seaman & Associates

34 West Sixth Street Cincinnati 2, Ohio

Mode; G-15D (Machine Language)

Date: October 23, 1959

1.) Double Conversion

Two single precision numbers are converted at the same time. This makes it possible to convert a full line of 198 words in 54 drum revolutions. With proper modifications it is possible to convert 90 words in 45 drum revolutions. However it is not possible with this program to convert less than 90 words and still have the total conversion time in drum revolutions equal to one-half the total number of words converted. (We have written another conversion routine which will convert 76 words in 38 drum revolutions but has an upper limit of 98 words converted in 49 drum revolutions. This routine does not disturb short lines.)

2.) Counter

An original counter is used in this routine. Besides signalling the end of the line as any other counter does, this counter also alternately changes its sign. This makes it possible to go to a different loop each time the counter is incremented. Note that the counter is selected in such a way that the overflow light is not turned on at the end of the subroutine. No location is used to keep the counter.

3.) Flow Diagram and Coding Sheet

The new type flow diagram used for this subroutine is easier to follow because of the timing and looping involved in this program. The new form of the coding sheet clearly sets out the commands and provides space for the programmer to keep track of short line storage.

ABSTRACT OF USERS PROJECT NO. 378

Class I

Title:

AROWA FLIT - 3 (FLIT)

Originator:

U. S. Navy Weather Research Facility

Building R-48

U. S. Naval Air Station Norfolk 11, Virginia

Mode:

Machine Language

Date:

23 October 1959

In the course of checking a machine language program, the programmer frequently finds it convenient to be able to interrupt his program at any point in the problem at which an error is suspected, and to then inspect and/or adjust any cell in the memory, without exception. The convenience to the operator is enhanced if, after making such interrogation or correction, he is able to restore the entire memory, including short lines, registers, IP flipflop, formats, and condition of overflow, to its original condition and to proceed from the point in his own program at which computation was interrupted. Flit is a program designed to provide these and other debugging conveniences.

Specifically, Flit enables the programmer to halt his own program at any point and interrogate the content of any cell either as a sexadecimal number or a (modified) standard command. Short lines, two-word registers, and the AR are interrogated like any other cell, and when they are so interrogated, their contents are displayed as they were left by the operator's program, and not as they are changed by Flit. Thus, although Flit itself uses the short lines and registers, the operator may proceed as though it did not. Similarly, in addition to interrogation, Flit enables the operator to place a breakpoint on, or remove a breakpoint from, any command in the memory; and to insert either a sexadecimal number or (modified) standard command into any cell, without exception. Any long line, except Line 19, may be punched on tape or typed in standard (or other) format by use of Flit. A long line of data may be transferred to or from Line 19, and information may enter the computer via punched tape or typewriter without destroying the stored contents of Line 23. Line 19, and hence any other line, may be cleared. Any long line may be checksummed. The above functions may be performed by the typing of one, and at most two, Flit instructions. All Flit instructions are obeyed as soon as they are typed, i.e. Flit need not read or search additional blocks of tape, and the giving of any Flit instruction in no way precludes the giving of any other instruction in the Flit repertoire. After any or all of the above functions have been executed, the operator may restore the memory to precisely the condition in which it stood at the time Flit was invoked, and may thereafter proceed, either at high speed or single-cycle, from any stipulated command in memory. Only the location of the Mark is not automatically restored, and even here, the operator may designate the location of the Mark.

Using Flit, it is not possible to enter a decimal fraction or integer, to be converted, into the memory, nor will Flit interrogate a cell as a decimal fraction or integer. Flit does not list or trace a program. When the content of a cell is interrogated as a command, it will always be displayed with a "u" or "w" prefix, depending on whether it is immediate or deferred, and when a command is inserted into the memory, it must similarly be in this form. Flit is not self-protecting, i.e. by injudicious use of Flit instructions, it is possible for the operator to ruin the Flit program in memory.

Two versions of Flit exist, one occupying Lines 05, 16, 17, and 18, and the other Lines 04, 06, 07, 08. Both are identical in function.

Instructions to Flit are entered through the G-15 typewriter, and consist of seven, five, or three typed digits, depending on the instruction. The machine's reaction to Flit instructions is sensibly immediate. In most cases, a carriage return occurs to denote completion of the instruction.

The CA-1 card reader and MTA-2 tape handler may both be turned on when Flit is in use, though neither of these is required.

DESIGN COMPUTATIONS

SHEET NO.____

MADE BY downing DATE 6-25-59

SUBJECT MATTER THREE COLUMN PIER ANALYSIS (1000S)

CHECKED BY____DATE

Abstract of Users Project No. 379

Class

2

Title: THREE COLUMN PIER ANALYSIS

Originator: Palmer & Baker Engineers, Inc. Address: P.O.Box 346, Mobile, Alabama

Date: July 15, 1959

The program is coded for the Bendix G-15D in Intercom 1000S.

The structure analyzed has three fixed-base columns, equally spaced and of equal height and of constant cross section. The cap beam is of constant section and may cantilever over the outside columns.

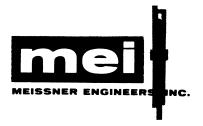
The structure is analyzed for uniform vertical loads on the cap beam, zero to two concentrated vertical loads on each cantilever, zero to four concentrated vertical loads on each span and a transverse horizontal load at the centerline of the cap beam.

The program will compute bending moments and shears at all joints of the frame and additional bending moments in the cap beam at all points of concentrated load.

Subroutines used: none

Auxiliary equipment used: none

Computation time: six minutes including type-in and output.



ABSTRACT OF USERS

Project No. 380

Class 2

Title:

Spiraled Bridge Detail Geometry

Originator:

Meissner Engineers, Inc. 300 West Washington Street

Chicago 6, Illinois

Mode:

Intercom 1000 D.P.

Date:

October 20, 1959

Description:

The program computes detail bridge beam data. The horizontal alignment may be on tangent and/or circular and/or spiraled alignment. The vertical alignment may be on tangent and/or vertical curve. The crown template may be normal and/or fully sperelevated and/or in superelevation transition.

Given the location of the beams at the piers: the program computes beam lengths, and framing angles into the pier. At any increment on the beam; stations, offsets and template elevations are computed.

The program uses the series expansion computation for spiral coordinates, and agreed with Barnett's Tables. The program is compatible with the latest revision of UP 223, "Spiraled Bridge Design Geometry".

The program uses typewriter input, and fixed point output.

Computation and type-out time is approximately 30 seconds for beam points on a horizontal tangent, and 1 minute for points on a spiral.

USERS PROJECT NO. 381

ABSTRACT

This program yields the step function

time response for transfer functions of sixth

order or less. Initial values used to begin

the numerical integration process are computed

automatically by the first portion of the program.

Thiokol Chemical Corporation does not accept or assume responsibility for any errors or misrepresentations which may occur during computations when using this program.

Title: Calculation of a correlation matrix (two to fourteen

variables).

Originator: Department of Animal Industry & Veterinary Science

Contact: C. J. Brown and J. M. Rakes

Address: University of Arkansas

Fayetteville, Arkansas

Mode: Intercom 1000, G-15 D, CA-1

Date: August 25, 1959

Summary:

Simple correlations among all combinations of variables (2 to 14 variables) are calculated and typed out with the mean and standard deviation for each variable. Any number of cards punched in floating point notation may be read by inserting a flag following the last data card. Ten columns of a card are used for card identification allowing seven floating point data positions in the remainder of the card. For 2 to 7 variables data input is from one card.

For 8 to 14 variables data input is from 2 cards. This program requires changes in index register setting to handle other than 7 or 14 variables. Alteration to handle data from paper tape may also be inserted.

Class 2

Title: STADIA NOTE REDUCTION

Originator: Richardson, Gordon and Associates

Address: 3 Gateway Center, Pittsburgh 22, Pennsylvania

Mode: Intercom 1000 Double Precision

Date: October 1, 1959

Given the height of instrument, elevation of the transit point and corresponding vertical angles, rod readings, and stadia readings this program will compute horizontal distances and vertical elevations.

The program is written to handle many types of instruments with known focal distance, transit image distance, and the distance from the center of instrument to principal focus.

Input consists basically of all the information mentioned above which can be taken directly from field notebooks by the computer operator.

The output format is shown in the write-up. The typeout gives the vertical angle, stadia distance, rod reading, horizontal distance, and ground elevation.

Even though much data input is involved, it is estimated that the time saved compared to the manual method is of the order of ten to one. Abstract of Users Project No. 384

Class 1

Title:

QUADRILATERAL ADJUSTMENT (LOGARITHMIC)

Originator:

U. S. Army Engineer District, Los Angeles

Corps of Engineers

Address:

751 S. Figueroa Street, Los Angeles 17, California

Mode:

Intercom 1000 D

Date:

September 1959

This program adjusts the angles of a quadrilateral. During solution, a sufficient number of iterations occurs to balance the sum of the log sines to the limit of accuracy of 8 place logarithms. If desired, the number of decimal places in the type-out can be varied to correspond with the accuracy of input data.

Conventional analysis and techniques are employed as set forth in the War Department Information Bulletin "Instructions for Survey Forms," dated 1 October 1944, paragraph 9, section b, page 27.

Input data required are the 8 observed angles within the quadrilateral. At end of solution, program gates for type-in of new data.

Output is in fixed point notation and consists of:

- (a) Degrees, minutes, seconds and decimal fractions of seconds of the 8 adjusted angles.
 - (b) Type-back of input angles.

Time required for solution is 50 seconds per iteration.

No auxiliary equipment is required.

ABSTRACT OF USERS PROJECT NO. 385

CLASS 2

TITLE:

PAYROLL JOB COSTS

Originator: Adress:

J. Stephen Watkins Consulting Engineers
446 East High Street, Lexington, Kentucky

Mode:

Machine Language (S. P.)

Date:

12 October 1959

Given time sheet information for each employee (i.e., hourly rate, job number and breakdowns under each, and hours worked on each), sort and accumulate this information for all employees and type the total amount for each cost code under each job number, the total cost of each job, and the total costs for a selected group of employees.

The program is set up to handle employees according to division (e.g., highway, administrative, sanitation, etc.), and there is no practical limit to the number of employees in a dvision. The total costs for a division, however, may not exceed \$99,999.99. Up to 10 division may be run without changing the program.

There are 864 cells available for storage of job numbers and cost code amounts for any one division. Therefore, the maximum number of jobs, times 1 plus the maximum number of cost breakdowns under each job, may not exceed 864. For example, with 23 cost breakdowns for each job, up to 36 jobs may be run $(36 \times (23+1) = 864)$.

All input is via Flexowriter tape. If more than one division is run, off-line data preparation may coincide with computation. Output consists of job numbers typed horizontally across the page, cost code numbers from 1 to the maximum typed down the left margin, cost amounts beneath the job numbers and opposite the correct cost code numbers, total amount for each job, and division total. Any job numbers which would exceed available storage are typed out as a flag, and computation continues automatically. All totals are correct to the penny.

Operating time of course depends on the number of employees and the number of different jobs worked on. On a test problem with 41 employees who worked on 46 different jobs, data preparation including verification required approximately 1 hour, and computation an additional 30 minutes.

A Flexowriter is required for data preparation.

DESIGN COMPUTATIONS

SHEET NO. 1 WYD DATE 6-19-59 MADE BY__

SUBJ	ECT MATTER_				CHECKED BY	DATE	
			INPUT-OUTPUT	SHEET			
	1101 1102 1103 1104 1105 1106 1107 1108		UNITS L1 Ft. L2 Ft. L3 Ft. L4 Ft. WD Kip/Ft WL Kip/Ft CL Kip WSW Kip/Ft		POSI Uniform Dea Uniform Liv Concentrate		
	Point	Dead Live		Sidewalk	•	ionali bivo boad	
	1234567890123456789012322222222333333333333333333333333333	Abstract of Users Project No. 386 Class Z Title: CONTINUOUS HIGHWAY BRIDGE GIRDER MAXIMUM-MINIMUM MOMENTS Originator: Palmer & Baker Engineers, Inc. Address: Post Office Box 346, Mobile, Alabama Mode: Intercom 1000S Date: June 5, 1959 This program continues Users Project No.24, "Influence Lines for Continuous Beams", to determine maximum- minimum design moment curves for 3 or 4 span continuous variable moment of inertia highway bridge girders. After Users Project No.24 has been run, a paper tape is made recording the out-put. The new program is read, along with the data tape, by Intercom 1000S. Input values as shown for dead and live load are entered and the program computes and types out maximum positive and negative moments through out the girder, due to dead loads, and live loads in position as required by A.A.S.H.O. Limitations are: Type of live load must be lane loads, not truck loads. The dead load must be considered as a uniform load. Computation time including input & output is approximately one hour.					
	38 39	No subroutin	-389		useu.		
:	1		2-1				

DESIGN COMPUTATIONS

SHEET NO.

MADE BY WYO DATE 7-6-59

CHECKED BY____

DATE...

SUBJECT MATTER

Abstract of Users Project No. 387 Class 2

Title:

Rigid-Frame Bridge

Influence Lines

Originator: Palmer & Baker

Engineers, Inc.

Address:

P.O. Box 346, Mobile, Alabama

Mode:

Intercom 1000S

Date:

July 6, 1959

The program computes Influence Lines for points through out the frame shown for vertical unit loads at points 6-14 and horizontal unit loads at points 1-5 and 15-19.

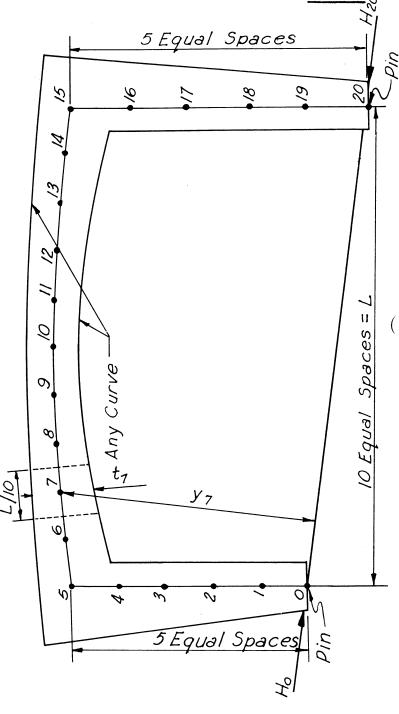
Input consists of slab thick-ness, "t" and coordinates, "y" for points 0-20 and horizontal span length "L".

Limitation: Pin Condition at

Base of Frame.

Computation Time: Approx-

imately one hour including Input and Output.



DESIGN COMPUTATIONS

SHEET	NO		
	mv/		

SUBJECT MATTER 2 COLUMN 2 STORY RIGID FRAME

CHECKED BY_____DATE____

Abstract of Users Project No. 388

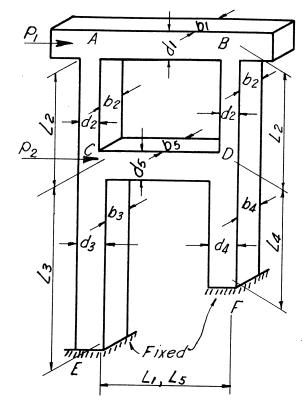
THE

Class

2

GENERAL

CONDITION



Title:

2 COLUMN 2 STORY RIGID FRAME

Originator:

PALMER & BAKER ENGINEERS, INC. P. O. Box 346, Mobile, Alabama

Address: Mode:

Intercom 1000S

Date:

November 6, 1959

The program is coded for the Bendix G-15D Computer, in Intercom 1000 Single Precision. No subroutines are necessary.

The structure analyzed is a two-story rigid frame consisting of two vertical, fixed-base columns, a horizontal cap with a cantilever at either or both ends, and a horizontal strut at some intermediate height. The size of the columns in the second story are assumed to be equal. All members are assumed to be prismatic.

The input is the sizes and lengths of all the members, the fixedend moments for any set of vertical loads, and the horizontal loads on the frame resolved into concentrated horizontal loads applied at the cap and strut center lines.

The program will compute the moments at the base of the columns and at all joints. The machine time required is five minutes.

STANLEY ENGINEERING COMPANY PROGRAM FOR BENDIX G-15 D COMPUTER SUPPLEMENT TO U. P. #203 GENERAL PURPOSE GEOMETRY

ABSTRACT TO USERS' PROJECT NO. 389
Submitted November, 1959
S.E.C. Program No. C-094
Class 1
Mode: DAISY 201

- A. This supplement adds to the horizontal curve solution of U. P. #203 another case (Δ and D may be the only known values) and provides for the computation of D, E, M and C for all cases. This supplement solves for the elements of the curve that are normally computed and handles five cases of curve problems.
- B. The input is unchanged except that case IA is added to allow input of Δ and D. Computation for this case is started at 007, the same as case one. A test, dependent on relative size, is made to determine whether D or R has been entered and computation proceeds accordingly.
- C. All other portions of the original program remain unchanged. The additional locations required for this supplement were unused in the original program. The entire program, including the supplement, is on the tape accompanying this project, but the original program write-up must be on hand to operate the program.

ABSTRACT OF USERS PROJECT NO. 390

Class 2

Title: INTERCOM 610

Originator: E. I. du Pont de Nemours & Co., Eastern Laboratory

Address: Gibbstown, New Jersey

Mode: Machine Language (Autopoint 24 Subroutines)

Date: December 7, 1959

INTERCOM 610 is a simplified programming system which makes the Bendix G-15D accept numbers and perform various arithmetic operations on them on command from the typewriter. Commands are executed at the time they are typed, and if the Punch Switch on the typewriter is turned on, the command will be punched on paper tape as well. For a repetitive series of operations, this program tape can be re-read and executed one command at a time. In this respect, the machine will then simulate the operation of the IBM 610 computer. There is provision for storing the program in memory for execution, in which case the system approaches the speed, although not the versatility, of INTERCOM 1000. There is also provision for listing or tracing programs stored in the memory.

There are 54 registers in which numbers may be stored, numbered consecutively from 00 to 53. The numbers stored in these locations may be thought of as having a total of 16 decimal digits, with 7 digits before the decimal point and 9 digits after the decimal point. The result of any arithmetic operation is automatically rescaled to this form.

Addition or subtraction may be carried out in any of the 54 registers. For example, the instruction Ofull will cause the number in register 11 to be added to register 06, with the answer appearing in register 06. Arithmetic operations such multiplication, division, and evaluation of functions will place the answer in the special A register, addressed 00. For example, the instruction 12x17 will place the product of the numbers in registers 12 and 17 in register 00. Operations available include: add, subtract, copy, multiply, divide, clear, absolute value, type in, type out, square root, e^{x} , 10^{x} , $\ln x$, $\log x$, sine, cosine, and arctangent. programs punched on tape or stored in memory, there are also instructions to transfer, transfer on negative, and change mode to tape or typewriter. There is no index register system and in order to repeat the same program on new numbers, it is necessary to store the new numbers in the addresses used formerly. If a program is stored in memory, there is provision for entering numbers from tape rather than from the typewriter.

USERS' PROJECT NO. 391

Abstract

Intercom 107

This is a complete revision of Intercom 103-D. It performs all the functions of 103-D, with certain added features.

Operation codes have been provided for individually selective format fixed point typeout, for inverse subtract, for reversing tape, and for returning to Compiler.

Processing of input typeout has been speeded up, also the listing operations. There are but two lines (00 and 04) which are different for the Interpreter than for the Compiler. Tapes from Intercom 101 and 103-D will be accepted, as there has been no change in the tape format.

There are three main points of difference to be noted when operating with Intercom 107:

- 1. Instruction for punching tape has been modified.
- 2. Break-in procedure in the Interpreter has been changed.
- 3. Control in the Compiler is in line 00, as well as in the Interpreter.

Also, since practically all typeout is from Line 19, certain restrictions have been placed on Stack operations.

Complete instruction manual is available.

No responsibility is assumed by the author or by Bendix Radio Division for any errors, mistakes, or misrepresentations that may occur during computations when using this program; further more, no responsibility is assumed by Bendix Computer Division for the correct reproduction of this program.

USERS' PROJECT NO. 391-A

Abstract and Special Instructions

Intercom 107 (Revised 7/22/60)

The purpose of this revision was to improve the operation of Intercom 107 at various points.

The Exponential routine has been completely rewritten for additional speed and accuracy.

Two new OP codes have been added to provide two levels of marking for subroutines. These are:

Ox (corresponds in function to 43)

Oy (corresponds in function to Щ)

Provision has been made for storing the A register on return to the Compiler. This means that a program may be interrupted, by the Break Point method, the compiler may be called in, any compiler function may be executed, the interpreter may be recalled, and the program may be restarted at the point left off by use of the "y" code.

The original program, due to an error in typing, would validate a "53" code, which was non-existent. This error has been corrected.

In the original program, there was difficulty in entering sequential listing, after an error signal due to a fixed-point overflow. This also has been corrected.

Complete coding sheets are now available.

No responsibility is assumed by the author or by Bendix Radio Division for any errors, mistakes, or misrepresentations that may occur during the computations when using this program; furthermore, no responsibility is assumed by Bendix Computer Division for the correct reproduction of this program.

Title:

BRIDGE END SPAN GEOMETRY

Class:

2

Mode:

Intercom 1000 D.P.

Originator:

Tippetts-Abbett-McCarthy-Stratton

Date:

November 27, 1959

DESCRIPTION

The program computes the length of end span of a skewed bridge, the elevation of the bottom of abutment footing and the station of the ends of the wing walls under specified conditions of embankment side slope.

INPUT

The required input data consist of:

- 1. Horizontal and vertical alignment of the upper and lower roadways.
- 2. Location of the lower roadway ditch lines.
- 3. Side slope of fill, and minimum embedment depth of footing.
- 4. Miscellaneous bridge data such as location of fascia stringers, distances between abutment faces and & end bearings, distances between ditch lines and & piers, etc.

OUTPUT

The output items are:

- 1. The length of end span for which the fill slope intersects the abutment face at a specified minimum distance below the upper roadway.
- 2. The elevation of the bottom of abutment footing which is embedded a specified minimum distance below the fill slope.
- 3. The station of the ends of the wing walls which extend a specified distance beyond the intersection of the side slope with the upper roadway shoulder lines.

LIMITATIONS

The program is limited to straight horizontal alignments but is unrestricted as to vertical alignments.

Title: FORECASTING SHIP ARRIVALS

Class: 1

Mode: Intercom 1000 S.P.

Originator: Tippetts-Abbett-McCarthy-Stratton

Date: December 10, 1959

The program generates a table of ordinates representing the percentage of time that a number of ships occupy berthing facilities in a commercial marine terminal. It was developed to determine the maximum practical berth occupancy in order to avoid stand-by time for one ship while another ship is occupying a berth. Poisson's Law of Random Distribution, represented by the following equation, is used.

$$P_{n} = \frac{Km^{n}e^{-m}}{n!}$$

m is the average number of ships in port
n is the number of ships in port on a given day
K is a constant = 100%
P_n is the percentage of time that n ships are in port
when m is the average number of ships in port

<u>Input</u> - The program will call for a type-in of the upper and lower limit of m, the amount by which m is varied, the amount by which n is varied $(n_d = 1.0)$, the constant K and a lower limit for $P_n = 99.98$ which operates as a control for the number of P_n values computed as well as a check of the computations.

 $\underline{\text{Output}}$ - The type-out will be the values of P_n , for each value of m, in tabular form horizontally across the page, followed by a type-out of the summation of the values of P_n for the value of m used.

<u>Limitation</u> - Overflow occurs for an upper limit of m = 16 when the computer will halt.

<u>Note</u> - This program was written to compute P_n for decimal values as well as integral values of m. However, published tables exist for the integral values of m.

ABSTRACT FOR USER'S PROJECT NO. 394

TITLE: Tangent, Circular Curve and Transition Spiral

Intersection, Offsets, Coordinates, Elevations,

Stationing and Concentric Arc Lengths

CLASS:

MODE: Intercom 1000 D.P.

ORIGINATOR: Clark, Daily and Dietz, 209-211 North Race

Street, Urbana, Illinois, through the facilities of Midwest Computer Service, Inc., 316 East Wood Street, Decatur, Illinois

DATE: September, 1959

This program was developed for solving problems such as ramp nose location, roadway elevations on a straight or curved grid, location of bridge bearings and piers, curve offsets at given distances along the curve of the tangent and etc.

The horizontal alinement is specified by the degree of curve, the length of Barrnet transition spiral (if any) and the station of the beginning of the curve.

The vertical alinement is specified by the station and elevation of the intersection of the profile grade lines, the slope of these lines and the length of the vertical curve. (One vertical curve only.)

The roadway cross section is specified by the station at which the superelevation rate is theoretically zero, the maximum superelevation rate, the length in which maximum superelevation is attained, the distance to each pavement from the base line, the two pavement widths on each side of the base line and the slope of the pavements in a normal section. (pavement rotates about inner edge)

The program contains five types of problem solutions. They are:

Case O. Given the degree of curve at the end of the transition spiral and the length of transition spiral the program computes the spiral functions in "Transition Curves for Highways" by Joseph Barrnet, Federal Works Agency, Public Roads Administration.

- Case I Given the alinement data as specified above, a length increment measured along the base line curve, a starting station, the last station and up to 26 radial distances measured to points offset from the base line; the program types the spiral functions, if a spiral exists, the curve length to the point on the base line, the coordinates of the point on base line with respect to the beginning of the horizontal curve, the elevation on the profile grade line radial from the point on the base line, the total deflection angle to that point measured from the tangent at the beginning of the curve and the station of the point on the base line, the point on the base line being determined from the starting station and the length increment. For each point offset radially from each point on the base line the following is computed: the concentric curve arc length, the coordinates and the elevation.
- Case II This problem is basically the same as Case I except the length increment is measured along the main tangent of the curve.
- Case III Given the alinement data as specified above, the station of the beginning of the curve on a route parallel to the main tangent of the curve and up to 12 sets of data describing points at a given radial distance from the base line curve and a perpendicular distance from the main tangent of the curve, the type out is the same as for Case I.
- Case IV Given the alinement data as specified above, the station of the beginning of the curve on a route parallel to the main tangent of the curve and up to 12 sets of data describing points at a given perpendicular distance from the main tangent of the curve and a distance measured along that tangent, the type out is the same as for Case I plus the radial distance from the base line to the point.

Elevations of the offset points and elevations of the points on the profile grade are optional.

Cases III and IV do not involve computation of points off set from the horizontal tangent portion of the alinement.

Abstract of	Users	Project	No	395	nga malawina atau atau atau ata
		Class		2	

Title:

DESIGN OF REINFORCED RECTANGULAR CONCRETE TANK

Originator:

Midwest Computer Service, Inc.

Address:

316 East Wood St., Decatur, Illinois

Language:

Intercom 1000 Single Precision

This program determines and types out the end moments, mid-span moments, unit shears, resisting moments and required steel areas for a one-foot wide strip cross-section in both vertical and a horizontal direction of a rectangular concrete tank.

The structure may be designed for two different wall conditions - walls hinged at top or walls fixed at top. In both cases the walls are fixed at the bottom and at the vertical corners.

The input data consists of tank dimensions, loading and physical properties of concrete and steel to be used.

The program is written in Intercom 1000, Single precision and makes use of the machine language square root sub-routine and the flexowriter input sub-routine.

The machine time varies depending upon the number of cycles required to balance the moment at the joints, but the average running time is about 35 minutes.

Title:

Roadway Elevations

Originator:

Parsons, Brinckerhoff, Hall & Macdonald

Address:

165 Broadway

New York 6, N. Y.

Mode:

Machine Language

Date:

December, 1959

General

This program produces profile elevations and roadway surface elevations at points defined by stations and offset distances. The points may be given in random order of stationing and may occur in normal, superelevated or transitional sections. The roadway may be for a single or dual roadway and may contain up to four lanes in each direction.

Input Data

The input data are arranged in four groups, as follows:

- 1. The theoretical profile data containing information for up to five vertical curves.
- Data which defines the horizontal geometry for up to three curves with or without intervening tangents and/or spirals. These data consist of the stations at which the various transitions begin and end.
- 3. Template data which specify the lane widths, cross-slopes and point of rotation for sections in transition. The point of rotation may be at the edge of pavement or at an interior lane joint.
- 4. The stations and offsets of the points whose elevations are desired.

An alignment made up of more than three horizontal and/or five vertical curves can be processed by dividing it into sections and using the program several times.

Output Data

The output from the program consists of both the theoretical profile elevation and the roadway surface elevation.

Program Limitations

The more significant program limitations are:

- 1. All transitions must be linear, i.e. any single transition must occur at a constant rate.
- 2. Only straight slope crowns can be used in the roadway cross-section.

Operating Time

Approximately 80-100 points can be processed in an hour.

Abstract of Users' Project No. 397 Class 2

Title:

Pier Location

Originator:

Parsons, Brinckerhoff, Hall & Macdonald

Address:

165 Braodway

New York 6, N. Y.

Mode:

Intercom 1000 D.P.

Date:

December, 1959

General

This program computes the data required for locating bridge piers for overpasses in accordance with the requirements for minimum sight distance or according to the minimum lateral clearance specified by the designer. The program works with a single span at a time; multi-span structures can be accommodated by using the program several times. Each roadway must be entirely on either a simple circular curve or on a tangent. The edges of the roadways must be parallel to (or concentric with) their respective baselines.

Input Data

The basic input data consist of: (1) the station of the point of intersection of the baselines of the two roadways; (2) the skew angle of the two roadways; (3) the radii of the baseline, driver's path, and edges of the lower roadway (or corresponding items if roadway is on a tangent); (4) the radius of the baseline of the upper roadway (or corresponding item if on tangent); (5) the width of the upper roadway; (6) minimum sight distance for the lower roadway; (7) minimum lateral clearance for each side of the lower roadway; (8) the width of each pier; and (9) the skew angles between piers.

Output Data

The output data consist of: (1) the station of each pier along the upper roadway; (2) the skew angle between each pier and the reference line of the upper roadway; (3) the theoretical lengths of each pier and (4) the theoretical spans of the overpass.

Operating Time

Approximately 15 minutes per span, including type-in.

No auxiliary equipment is required.

J. E. GREINER COMPANY

Consulting Engineers Baltimore, Maryland

ABSTRACT No. 398

Program Class 2

Machine Language Vertical Alignment Program

This program computes profile elevations at predetermined intervals along a specified profile. One pass of the program will compute a maximum of 24 P.V.I.'s, 24 different computing intervals, 24 station equalities, and an unlimited number of special stations.

Program output includes a tabulation of basic input data for identification and a sequential listing of station numbers and their corresponding profile elevations.

Use of the program requires a single-precision off-line tape punch, or the equivalent, and it will produce answers at a rate of nearly 19 per minute.

Abstract of Users' Project No. 399 Class 1

Title:

Bowling Scores

Originator:

J. E. Greiner Company

Address:

1106 North Charles Street, Baltimore, Maryland

Mode:

Basic G-15D

Off Line Tape Punch

Date:

December 1959

Computer Program G-22.3902

(Machine language, Single Precision, Fixed Point, Tape input)

This program accepts individual scores for three games of bowling for ten bowling teams; determines high single game for men, ladies, and team; determines high three games for men, ladies, and team; and determines for each bowler, year-to-date records of total games, total pins, average, and handicap.